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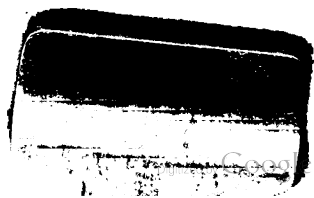
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Key
TO THE *Florian Cajori.*

WESTERN CALCULATOR,

CONTAINING

THE SOLUTION OF ALL THE EXAMPLES AND
QUESTIONS FOR EXERCISE,

WITH REFERENCE TO THE PAGES WHERE THEY STAND.

TO WHICH IS ADDED,

Some Useful Rules.

DESIGNED CHIEFLY TO FACILITATE THE LABOUR OF TEACHERS;
AND ASSIST SUCH AS HAVE NOT THE OPPORTUNITY
OF A TUTOR'S AID.

BY JOHN ARMSTRONG.

Third Edition, revised and corrected.

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.....

1831.


JOSEPH B HAMMON

QA43

A7

1831

WESTERN DISTRICT OF PENNSYLVANIA, to wit:

 *  *
 * SEAL. *
 * *****
BE IT REMEMBERED, That on the twenty-fourth day of April, in the forty-eighth year of the Independence of the United States of America, A. D. 1824, *Eichbaum & Johnston*, of the said district, have deposited in this office the title of a book, the right whereof they claim as proprietors in the words following, to wit:

"A Key to the Western Calculator, containing the solution of all the examples and questions for exercise, with reference to the pages where they stand.—To which is added, some Useful Rules. Designed chiefly to facilitate the labour of teachers; and assist such as have not the opportunity of a tutor's aid. By JOHN ARMSTRONG."

In conformity to the act of the Congress of the United States, entitled, "*An act for the encouragement of learning, by securing the copies of maps, charts and books, to the authors and proprietors of such copies, during the time therein mentioned.*"—And also to the act, entitled, "*An act supplementary to an act, entitled, 'An act for the encouragement of learning, by securing the copies of maps, charts and books, to the authors and proprietors of such copies, during the time therein mentioned,' and extending the benefits thereof to the arts of designing, engraving, and etching historical and other prints.*"

Wm. WALKER,
Clerk of the Western District of Pennsylvania.

CAJORI

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Arithmetical Marks and Signs.

- $=$ The sign of equality, and is pronounced *equal*.
 $+$ The sign of addition, pronounced *added to*.
 $-$ The sign of subtraction, pronounced *subtracted by*.
 \times The sign of multiplication, pronounced *multiplied by*.
 \div The sign of division, pronounced *divided by*.
 $:$ The sign of proportion, pronounced *is to, so is, to*.
 \oslash Sign of difference, pronounced *the difference between*.
 $\sqrt{}$, or $\frac{1}{2}$, The sign of the square root.
 $\sqrt[3]{}$, or $\frac{1}{3}$, The sign of the cube root.
 7^2 , Denotes that the number 7 is to be squared.
 8^3 , Denotes that the number 8 is to be cubed.
 \therefore That is.
 --- Vinculum, and () parenthesis.

Examples.

$12+7=19$; twelve added to 7 is equal to nineteen.
 $23-8=15$; twenty-three subtracted by eight, equal fifteen
 $9\times 8=72$; nine multiplied into eight equal seventy-two
 $24\div 3=8$; twenty-four divided by three equal eight.

Sometimes the division of one number by another, is expressed in the manner of a vulgar fraction; thus $\frac{27}{9}=3$, twenty-seven divided by nine equal three. Multiplication is also frequently denoted by this mark. thus $7.12=84$, seven into twelve equal eighty-four

$6:9::8:12$; as 6 is to 9 so is 8 to 12.

$A \oslash Z$; read the difference between A and Z.

$\sqrt{81}=9$, or $81^{\frac{1}{2}}=9$; the square root of 81 equals 9.

$10:100::1:10$; as 10 is to 100 that is as 1 is to 10.

A vinculum is placed over several quantities to denote that they are to be considered as one simple quantity; a parenthesis is often used for the same purpose.

KEY

TO THE

WESTERN CALCULATOR.

NUMERATION.

Page 8.

Example 1. 16 2. 49

Page 9.

3. 385 4. 2610 5. 64536 6. 253842
7. 5600006 8. 90000305 9. 829006002

1. Five.
2. Seventeen.
3. Thirty-five.
4. Four hundred and fifty-eight.
5. Six thousand, eight hundred and twenty-nine.
6. Seventy-two thousand, three hundred and forty-eight.
7. Three hundred and eighty-four thousand, seven hundred and twenty-one.
8. Two millions, six hundred and eighty-three thousand, two hundred.
9. Fifty millions, six hundred and seventy-eight thousand and twenty-four.

ADDITION.

Page 10.

2. 1581366	3. 2468727092
4. 2284038452	5. 2263764650
6. 2968194198	7. 5831333360
8. 5075438465	9. 9750563355
10. 36447728180651	11. 3847099705007

Application.

Page 11.

1. 123	2. 129	dolls.	barrels	dolls.
23	654	3. A 125	4. 60 for	480
16	8070	B 286	75	675
2060	10000	C 29	220	2200
8009574	4000000	D 672	126	1386
6				
8011804	4018853	\$ 1112	481 bbls.	4741 dols

5. 297	6. 1209	7. 1811	dolls.
125	476	21	
754	8017		8. George 3560
127	3119221	1832	William 3240
245			Samuel 2850
1548	3128923		Henry 2555
			Thomas 2226
			14431

SUBTRACTION.

Page 12.

3. 44064062638	4. 5390534442
5. 56053355680	6. 00000001

Application.

1. 1818	2. 5648	barrels
1777	3460	3. 1260
41	2188	
		sells to A 320
		B 435
		sold in all 755
		unsold 505
4. 6000	cents	cents
600	5. 145	35 penknife
5400	75	25 slate
	40	64 paper
		30 apples
	given him 260	
	given away 154	154
	left 106	

MULTIPLICATION.

Case 1. Page 13.

$$\begin{array}{r} 2. \quad 24639576 \\ \quad \quad \quad 4 \\ \hline \end{array}$$

$$98558304$$

$$\begin{array}{r} 3. \quad 3675432568 \\ \quad \quad \quad 8 \\ \hline \end{array}$$

$$29403460544$$

Page 14.

$$\begin{array}{r} 5. \quad 476824753 \\ \quad \quad \quad 5 \\ \hline \end{array}$$

$$2384123765$$

$$\begin{array}{r} 8. \quad 2901946808 \\ \quad \quad \quad 9 \\ \hline \end{array}$$

$$26117521272$$

$$\begin{array}{r} 6. \quad 964703024 \\ \quad \quad \quad 6 \\ \hline \end{array}$$

$$5788218144$$

$$\begin{array}{r} 7. \quad 74020006 \\ \quad \quad \quad 8 \\ \hline \end{array}$$

$$592160040$$

$$\begin{array}{r} 9. \quad 246354276 \\ \quad \quad \quad 11 \\ \hline \end{array}$$

$$2709897036$$

Case 2.

$$\begin{array}{l} 2. \text{ Mult. } 68523047653 \\ \text{by } 2867 \end{array}$$

$$479661333571$$

$$411138285918$$

$$205569142959$$

$$137046095306$$

$$162194053794651$$

Page 15.

$$\begin{array}{l} 3. \text{ Mult. } 5221 \\ \text{by } 145 \end{array}$$

$$26105$$

$$20884$$

$$5221$$

$$757045$$

$$\begin{array}{l} 4. \text{ Mult. } 23430 \\ \text{by } 230 \end{array}$$

$$702900$$

$$4686$$

$$5388900$$

$$\begin{array}{l} 5. \text{ Mult. } 3800920 \\ \text{by } 80750 \end{array}$$

$$190046000$$

$$2660644$$

$$30407360$$

$$306924290000$$

$$\begin{array}{l} 6. \text{ Mult. } 89536925 \\ \text{by } 735 \end{array}$$

$$447684625$$

$$263610775$$

$$626758475$$

$$65800639875$$

$$\begin{array}{l} 7. \text{ Mult. } 78969587 \\ \text{by } 5893 \end{array}$$

$$236897961$$

$$710693888$$

$$631727896$$

$$394829935$$

$$465346561391$$

$$\begin{array}{l} 8. \quad 1.15 \\ \quad \quad 75 \end{array}$$

$$575$$

$$805$$

$$\$86.25$$

$$\begin{array}{r} 9. \quad 3950 \\ \quad \quad 29 \\ \hline \end{array}$$

$$35550$$

$$7900$$

$$\$1145.50$$

$$\begin{array}{r} 10. \quad 40 \\ \quad \quad 12 \\ \hline \end{array}$$

$$480 \text{ pence}$$

Case 3. Page 15.

$$\begin{array}{r}
 2. \text{ Mult. } 871075 \\
 \text{by } 21 \quad 3 \\
 \hline
 2613225 \\
 7 \\
 \hline
 18292575
 \end{array}$$

$$\begin{array}{r}
 3. \text{ Mult. } 2453642 \\
 \text{by } 36 \quad 6 \\
 \hline
 14721852 \\
 6 \\
 \hline
 88331112
 \end{array}$$

$$\begin{array}{r}
 4. \text{ Mult. } 43102 \\
 \text{by } 64 \quad 8 \\
 \hline
 344816 \\
 8 \\
 \hline
 2758528
 \end{array}$$

$$\begin{array}{r}
 5. \text{ Mult. } 23645 \text{ by } 144 \\
 12 \\
 \hline
 283740 \\
 12 \\
 \hline
 3404880
 \end{array}$$

$$\begin{array}{r}
 6. \text{ Mult. } 12071 \text{ by } 99 \\
 9 \\
 \hline
 108639 \\
 11 \\
 \hline
 1195029
 \end{array}$$

Case 4. Page 16.

$$\begin{array}{r}
 2. \text{ Mult. } 3600 \\
 \text{by } 400 \\
 \hline
 1440000
 \end{array}$$

$$\begin{array}{r}
 3. \text{ Mult. } 44000 \\
 \text{by } 550000 \\
 \hline
 220 \\
 220 \\
 \hline
 24200000000
 \end{array}$$

$$\begin{array}{r}
 4. \text{ Mult. } 663000 \\
 \text{by } 60000 \\
 \hline
 39780000000
 \end{array}$$

NOTE. *Ex.* 1. $200 \times 10 = 2000$
 2. $462 \times 100 = 46200$
 3. $879 \times 1000 = 879000$

Application.

1. 15	2. 125	3. 32 cents
25	43	440
<hr/>	<hr/>	<hr/>
75	375	1280
30	500	128
<hr/>	<hr/>	<hr/>
dolls. 375	dolls. 53,75	dolls. 140,80

4. $60 \times 125 = 75,00$ wheat	5. 100	6. 32
$40 \times 85 = 34,00$ rye	10	sub. $20 \times 24 = 480$
$34 \times 50 = 17,00$ corn	<hr/>	<hr/>
<hr/>	1000 dimes	$12 \times 18 = 216$
\$ 126,00 amount	10	<hr/>
	<hr/>	panes 696
	10000 cents	

Page 17.

7. 7525	8. dolls. 250 A's	8 250 A
125	3	750 B
<hr/>	<hr/>	3000 C
37625	750 B's	
15050	4	4000 altogether
7525	<hr/>	
<hr/>	3000 C's	
940625		

DIVISION.

Case 1.

3. 4)4756394344	4. 5)97036142	5. 8)37846210
<hr/>	<hr/>	<hr/>
1189098586	19407228 $\frac{2}{3}$	4730776 $\frac{2}{3}$
6. 12)64381259	7. 6)3824966	8. 7)46825486
<hr/>	<hr/>	<hr/>
5365104 $\frac{11}{12}$	637494 $\frac{2}{3}$	6689355 $\frac{4}{7}$
	9. 9)8297463813	
	<hr/>	
	921940423 $\frac{5}{9}$	

Case 2. Page 18.

divisor	dividend	quot.	4. 735)47989536925(65291886 quotient
3. 64)	29687624	(463869	4410 735
256	64		
<hr/>	<hr/>		<hr/>
408	1855476		3889 326459435*
384	2783214		3675 195875759
<hr/>	<hr/>		<hr/>
247	29687616		2145 457043209
192	8 rem.		1470 47989536925 proof
<hr/>	<hr/>		<hr/>
556	29687624 proof		6753
512			6615
<hr/>			<hr/>
442			1386
384			735
<hr/>			<hr/>
584			6519
576			5880
<hr/>			<hr/>
8 rem.			6392
			5880
			<hr/>
			5125
			4410
			<hr/>
			715 rem.

* Add in the remainder as you multiply when working the proof.

$$5. \quad 2359 \overline{) 417968967} \quad (2084768$$

$$\begin{array}{r}
 4718 \quad 2359 \\
 \hline
 19996 \quad 18762917 \\
 18872 \quad 10423845 \\
 \hline
 \quad 6254306 \\
 11248 \quad 4169537 \\
 9436 \quad \hline
 4917968967 \text{ proof} \\
 18129 \\
 16513 \\
 \hline
 16166 \\
 14154 \\
 \hline
 20127 \\
 18872 \\
 \hline
 1255 \text{ rem.}
 \end{array}$$

$$6. \quad 671 \overline{) 5374608} \quad (8009$$

$$\begin{array}{r}
 5368 \quad 671 \\
 \hline
 6608 \quad 8018 \\
 6039 \quad 56069 \\
 \hline
 \quad 48059 \\
 569 \quad \hline
 5374608
 \end{array}$$

$$7. \quad 175296 \overline{) 19842712000} \quad (113195$$

$$\begin{array}{r}
 175296 \quad 175296 \\
 \hline
 231311 \quad 679170 \\
 175296 \quad 1018763 \\
 \hline
 \quad 226392 \\
 560152 \quad 565976 \\
 525888 \quad 792373 \\
 \hline
 \quad 113195 \\
 342640 \quad \hline
 175296 \quad 19842712000 \\
 \hline
 1673440 \\
 1577664 \\
 \hline
 957760 \\
 876480 \\
 \hline
 81280
 \end{array}$$

$$8. \quad 108 \overline{) 5704392} \quad (52818$$

$$\begin{array}{r}
 540 \quad 108 \\
 \hline
 304 \quad 422552 \\
 216 \quad 528184 \\
 \hline
 883 \quad 5704392 \\
 864 \\
 \hline
 199 \\
 108 \\
 \hline
 912 \\
 864 \\
 \hline
 48
 \end{array}$$

Case 4. Page 19.

$$2. \quad 6 \overline{) 100} 876 \overline{) 54}$$

$$146 \quad 54 \text{ rem.}$$

$$3. \quad 8 \overline{) 10} 2834 \overline{) 7}$$

$$354 \quad 27 \text{ rem.}$$

$$4. \quad 16 \overline{) 100} 1370 \overline{) 100} 85$$

$$128$$

$$90$$

$$80$$

$$1000 \text{ rem.}$$

NOTE.

$$2. \quad 1 \overline{) 100} 256 \overline{) 54}$$

$$\text{or } 256 \text{ quot. } 54 \text{ rem.}$$

$$3. \quad 1 \overline{) 1000} 876 \overline{) 1029}$$

$$\text{or } 876 \text{ quot. } 29 \text{ rem.}$$

$$4. \quad 1 \overline{) 10000} 80 \overline{) 10000}$$

$$\text{or } 80 \text{ quot.}$$

Application.

$$1. \quad 855 \overline{) 4275} (5 \text{ boys}$$

$$4275$$

Page 20.

$$\begin{array}{r} 2. \quad 28)2072(74 \\ \underline{196} \\ 112 \\ \underline{112} \\ - \end{array}$$

$$\begin{array}{r} 3. \quad 75)45000(600 \\ \underline{450} \\ 00 \end{array}$$

$$\begin{array}{r} 4. \quad 8164 \\ \underline{10 \text{ subtract}} \\ 27)8154(302 \\ \underline{81} \\ 54 \\ \underline{54} \end{array}$$

5. Here begin with the 150 and work backwards.

thus 5)150

$$\begin{array}{r} \underline{30} \\ 12 \text{ subtract} \\ - \end{array}$$

$$\begin{array}{r} 2)18 \\ - \end{array}$$

9 Ans.

6. 13440 dollars

$$\frac{1}{4} = 3360 \text{ eldest son's share}$$

$$\frac{1}{5} = 2688 \text{ 2d son's } "$$

$$\frac{1}{6} = 2240 \text{ 3d son's } "$$

$$\frac{1}{7} = 1920 \text{ 4th son's } "$$

$$\frac{1}{8} = 1680 \text{ 5th son's } "$$

$$\underline{11888} \text{ sum of 5 shares}$$

then 13440

$$\underline{11888} \text{ subtract}$$

$$\underline{1552} \text{ 6th son's share}$$

$$\begin{array}{r} 7. \quad 72084)5190048(72 \\ \underline{504588} \end{array}$$

$$\begin{array}{r} 144168 \\ \underline{144168} \end{array}$$

8. Because A has 10 cents per day more than B, and B 10 cents per day more than C, it is evident that A will get in all 8 dollars more than C, and B 4 dollars more than C, which together is 12 dollars.

$$\begin{array}{r} \text{then from } 228 \\ \text{take } 12 \end{array}$$

Divide by the number of persons 3)216

72 C's share
consequently 76 B's share
and 80 A's share

$$\begin{array}{r} 9. \quad \text{half Eagle} \quad 500 \\ \text{half a dollar} \quad 50 \\ \text{quarter dollar} \quad 25 \\ \underline{\hspace{1cm}} \end{array}$$

575 cents

$$\begin{array}{r} 575)1437,50(250 \\ \underline{1150} \end{array}$$

$$\begin{array}{r} 2875 \\ \underline{2875} \end{array}$$

10. Captain 6 shares Then 5|0)455|0

Mate 4 "

Seamen 40 "

No. of shares 50

dolls. 91 one seaman's share
Now $91 \times 6 = 546$ Capt. share
And $91 \times 4 = 364$ mate's share

FEDERAL MONEY.**ADDITION. Page 22.**

2. Dolls. 19320,43

3. Dolls. 204588,00½

SUBTRACTION.

2. Dolls. 325216,94¼

3. Dolls. 126723,53½

MULTIPLICATION. Page 23.

2. Dolls. 15823,50

3. Dolls. 57408,79½

DIVISION.

2. Dolls. 726,55

3. Dolls. 10343,79½

PROMISCUOUS QUESTIONS.

E d d c m
 Quest. 1. 25,0,0,0,0
 6,2,0,0,0
 8,0,0
 7,5,5

 31,3,5,5,5

Or, \$ 313 55½ cts.

3. Sugar \$ 39,87½
 Coffee 22,18½
 Tea 2,12½

 \$ 64,18½

Dolls.
 2. 1055 in notes
 260 gold
 3650 silver
 250 cents

 \$ 4967,50

4. From \$ 645,95½
 Take 350,00

 \$ 295,65½

5. Lent \$ 1000,00

Received at
 sundry pay'ts. { 160,25
 285,66½
 300,28¾

Received in all \$ 746,20¼

Unpaid \$ 253,79¾

8. \$ 17,37½
 132

3474
 5211
 173766

 \$ 2293,50

6. \$ 102,19
 Mult. by 120

 \$ 12262,80

7. Dolls. 4,50
 16

 \$ 72,00

9. 5)6022,50

 \$ 1204,50

Page 23.

10. 18)252.90(14.05

18

72

72

90

11. 45)22.50(50 cts.

225

0

Page 24.

12. 25)15555,50(622d. 22c.

COMPOUND ADDITION.

ENGLISH MONEY. Page 25.

2. £136739 6 3½

3. £15725 11 11½

TROY WEIGHT.

2. lb. oz. dwt. gr.
22 7 6 63. lb. oz. dwt. gr.
33 0 9 19

AVOIRDUPOIS WEIGHT. Page 26.

1. T. cwt. gr. lb. oz. dr.
128 12 1 18 14 102. T. cwt. gr. lb. oz. dr.
2921 3 0 9 0 8

APOTHECARIES' WEIGHT.

1. lb. oz. dr. sc. gr.
24 4 5 2 162. lb. oz. dr. sc. gr.
220 2 0 2 10

CLOTH MEASURE.

1. Yds. qr. na.
215 2 02. E. Fl. qr. na.
173 0 03. E. Fr. qr. na.
128 4 04. E En. qr. na.
221 0 2

LONG MEASURE. Page 27.

1. deg. m. fur. po. yd. ft. in. bc.
207 27 5 6 1 0 4 02. L. M. fur. yds. ft. in.
13 2 3 167 2 10

LAND MEASURE. Page 28.

1. A. R. P.
161 1 292. A. R. P.
2134 2 233. A. R. P.
1999 2 32

CUBIC, OR SOLID MEASURE.

1. Co. ft. in.
26 4 14072. T. ft. in.
21 16 15423. T. ft. in.
271 26 1294

TIME. Page 29.

	Y.	mo.	d.	h.	mi.	sec.		Y.	d.	h.	mi.	sec.
1.	104	2	26	13	23	27	2.	14	240	4	4	33

MOTION.

	sig.	deg.	mi.	sec.		sig.	°	'	"
1.	9	16	9	17	2.	10	12	45	23

LIQUID MEASURE. Page 30.

	T.	hhd.	gal.	qt.	pt.		T.	hhd.	gal.
1.	20	0	15	3	1	2.	79	0	11

DRY MEASURE.

	bu.	P.	qt.		bu.	P.	qt.		bu.	P.	qt.
1.	175	2	3	2.	1553	3	4	3.	41920	0	7

COMPOUND SUBTRACTION.

Page 31.

	T.	cwt.	qr.	lb.	oz.	dr.		mi.	fur.	P.	ft.	in.	ba.
2.	156	19	0	22	2	6	3.	124	5	34	4	7	2

	bu.	P.	qt.	pt.		D.	h.	mi.	sec.
4.	53	3	4	1	5.	88	21	44	54

	T.	hhd.	gal.	qt.	pt.		sig.	deg.	mi.	sec.		A.	R.	P
6.	29	2	47	3	1	7.	2	22	15	41	8.	408	2	22

Promiscuous Questions in Compound Addition and Subtraction.

Quest.	No.	yds.	qr.	na.		£.	s.	d.
1.	1,	36	3	2	2.	1st.	6	2 4
	" 2,	45	1	3		2d.	5 10	9½
	" 3,	48	2	1		3d.	7 0	0
	" 4,	52	0	3		4th.	8 10	6
	" 5,	64	2	0		5th.	9 2	6
		<hr/>					<hr/>	
		yards	247	2 1			£36 6 1½	cost
					Received		£22 10 6	
							<hr/>	
					Note		£13 15 7½	

Page 32.

	lb.	oz.	dwt.	gr.		lb.	oz.	dr.	sc.	gr.
Quest. 3. Bought	26	9	10	0	4. Bought	6	10	6	2	0
Wrought up	18	0	16	10	Used	4	5	4	1	17
Has left	lb. 8	8	13	14		lb. 2	5	2	0	3

	yr.	mo.	day.	hr.	
5. Charles born	1817	3	20	9 evening	
William born	1816	1	15	6 morning	

Year 1 2 5 15

	Cwt.	qr.	lb.
6. 1st.	18	2	14
2d.	16	3	18
3d.	22	0	24
4th.	24	1	0
Cwt.	82	0	0

Or, 4 Ton, 2 cwt.

	yds.
7. sold to A	54
B	64
C	74
	204

yds. 40 sold and left.

	yds.
Then from	55
take	40

yds. 15 for D and E.
But because F has half as much as D, and together have 15; therefore D has 10, and E has 5.

	gals.
8. bought 1 pipe	=126
2 hhds.	=126
3 quarter casks	{ 26
	{ 26
	{ 26

	gals.
sold 1 hhd.	63
2 qr. casks	52
leaked { pipe	17
	{ hhd. 11
	{ cask 54

330 bought
148½ sold and leaked

gallons 148½

181½ left

	E.	Fr.	qr.	na.	yds.	qr.	na.
9. Bought							
two first	{ 9	3	2=14	1	2		
	{ 9	3	2=14	1	2		
two last	{ 8	2	3=12	2	3		
	{ 8	2	3=12	2	3		

yards 54 0 2
40 2 0

13 2 2 yards left.

COMPOUND MULTIPLICATION.

Case 1. Page 33.

	<i>T.</i>	<i>cwt.</i>	<i>qr.</i>	<i>lb.</i>	<i>oz.</i>	<i>dr.</i>		<i>lb.</i>	<i>oz.</i>	<i>dwt.</i>	<i>gr.</i>			
2.	146	2	3	14	6	1	3.	71	10	17	7			
	<i>bu</i>	<i>pc.</i>	<i>qt.</i>		<i>hhd</i>	<i>gal.</i>	<i>qt.</i>	<i>pt.</i>		<i>deg.</i>	<i>mi.</i>	<i>fur.</i>	<i>p.</i>	
4.	199	3	0		5.	283	33	2	1	6.	67	18	6	32
	<i>yds.</i>	<i>ft</i>	<i>in.</i>	<i>bc.</i>		<i>A.</i>	<i>R.</i>	<i>P.</i>		<i>bu.</i>	<i>pc.</i>	<i>qt.</i>		
7.	149	1	4	0	8.	809	0	34	9.	538	1	2		
	<i>d</i>	<i>h</i>	<i>mi.</i>	<i>sec.</i>		<i>yrs.</i>	<i>m.</i>	<i>w.</i>	<i>d.</i>					
10.	763	8	44	15	11.	1508	2	2	6					

Application.

	£.	s.	d.		£.	s.	d.
Quest. 1.	2	6	4	2.	1	2	6½
			5				9
	£11	11	8		£10	2	8½
	£.	s.	d.		£.	s.	d.
3.	0	12	9½	4.	2	4	2½
			11				12
	£7	0	8½		£26	10	6

Case 2. Page 34.

Application.

	T.	cwt.	qr.	lb.	oz.	dr.	
1.	4	3	1	16	8	10	by 36
						6	
	25	0	1	15	3	12	product by 6
						6	
	150	2	1	7	6	8	product by 36

	£.	s.	d.	
2. Mult.	120	6	9	by 24
			6	
	722	0	6	product by 6
			4	
	2338	2	0	product by 24

	T.	cwt.	qr.	lb.	
3. Mult.	24	4	2	7	by 48
				12	
	290	14	3	0	pro. by 12
				4	
	1162	19	0	0	pro. by 48

Case 3. Page 34.

	d.	h.	mi.	sec.	
2. Mult.	4	12	5	by 29	
			4		
	32	16	48	20	product by 4
			7		
	223	21	38	20	product by 28
	8	4	12	5	" 1
days	237	1	50	25	product by 29

Case 4. Page 35.

s.	d.		£.	s.	d.
2.	14	6	3.	1	2
		10			3×7
					10
	7	5		11	2
		0×4			6×1
		10			10
	72	10		111	5
		0			0 val. of 100
		2		11	2
					6 ' ' 10
	145	0		7	15
		0 value of 200			9 ' ' 7
	29	0		£130	3
		0 ' of 40			3 val. of 117
£174	0	0 value of 240			
	£.	s.	d.		
4.	1	2	6×5		
			10		
	11	5	0×7		
			10		
	112	10	0		
			2		
	225	0	0 value of 200		
	78	15	0 ' of 70		
	5	12	6 ' of 5		
£309	7	6 value of 275			

COMPOUND DIVISION.

Case 1. Page 36.

- $\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \\ 2. \text{ Ans. } 187 \quad 18 \quad 5\frac{1}{2} \end{array}$
 $\begin{array}{r} \text{T. cwt. gr. lb.} \\ 3. \text{ Ans. } 15 \quad 6 \quad 0 \quad 7 \end{array}$
- $\begin{array}{r} \text{yds. ft. in} \\ 4. \text{ Ans. } 192 \quad 0 \quad 4\frac{1}{2} \end{array}$
 $\begin{array}{r} \text{T. hhd. gal. qt.} \\ 5. \text{ Ans. } 58 \quad 2 \quad 18 \quad 3\frac{1}{2} \end{array}$
- $\begin{array}{r} \text{w. d. h. mi. sec.} \\ 6. \text{ Ans. } 3 \quad 0 \quad 16 \quad 16 \quad 53 \end{array}$

Case 2.

- $\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \\ 2. \quad 11 \overline{)134} \quad 18 \quad 8 \end{array}$
 $\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \\ 3. \quad 12 \overline{)984} \quad 0 \quad 0 \end{array}$
- $\begin{array}{r} 4) 12 \quad 5 \quad 4 \text{ quot. by } 11 \\ \hline \text{£} 1 \quad 4 \quad \text{by } 44 \end{array}$
 $\begin{array}{r} 12) 82 \quad 0 \quad 0 \text{ by } 12 \\ \hline \text{£} 6 \quad 16 \quad 8 \text{ by } 144 \end{array}$
- $\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \\ 4. \quad 12 \overline{)474} \quad 0 \quad 0 \end{array}$
- $\begin{array}{r} 6) 39 \quad 10 \quad 0 \text{ quotient by } 1 \\ \hline \text{£} 6 \quad 11 \quad 8 \quad \text{by } 7 \end{array}$

Case 3. Page 37.

- $\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \\ 2. \quad 345 \overline{)109} \quad 13 \quad 9 \\ \quad \quad 345 \\ \quad \quad \hline \quad \quad 64 \\ \quad \quad \quad 20 \\ \quad \quad \quad \hline \quad \quad 1293 \text{ (3s.} \\ \quad \quad \quad 1035 \\ \quad \quad \quad \hline \quad \quad \quad 258 \\ \quad \quad \quad \quad 12 \\ \quad \quad \quad \quad \hline \quad \quad \quad 3105 \text{ (9d.} \\ \quad \quad \quad \quad 3105 \end{array}$
- $\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \\ 3. \quad 232 \quad 4 \quad 9 \\ \quad \quad \quad \text{£0} \\ \quad \quad \quad \hline \quad \quad \quad \text{s.} \quad \text{d.} \\ \quad \quad \quad 524 \overline{)4644} \quad (8 \quad 10\frac{1}{2} \quad 1\frac{1}{2} \\ \quad \quad \quad \quad 4192 \\ \quad \quad \quad \quad \hline \quad \quad \quad \quad 452 \\ \quad \quad \quad \quad \quad 12 \\ \quad \quad \quad \quad \quad \hline \quad \quad \quad \quad 524 \overline{)5433} \quad (10d. \\ \quad \quad \quad \quad \quad 524 \\ \quad \quad \quad \quad \quad \hline \quad \quad \quad \quad \quad 193 \\ \quad \quad \quad \quad \quad \quad 4 \\ \quad \quad \quad \quad \quad \quad \hline \quad \quad \quad \quad \quad 524 \overline{)772} \quad (1qr. \\ \quad \quad \quad \quad \quad \quad 524 \\ \quad \quad \quad \quad \quad \quad \hline \quad \quad \quad \quad \quad \quad 248 \text{ rem.} \end{array}$

Page 37.

$$\begin{array}{r} \text{£. s. d.} \\ 4. \quad 654)3236 \quad 12 \text{ 4} \frac{1}{2} \quad (\quad 4 \quad 18 \quad 11 \frac{1}{2} \\ \underline{2616} \end{array}$$

$$\begin{array}{r} 620 \\ 20 \end{array}$$

$$\begin{array}{r} 654)12412(18\text{s.} \\ \underline{654} \end{array}$$

$$\begin{array}{r} 5872 \\ 5232 \end{array}$$

$$\begin{array}{r} 640 \\ 12 \end{array}$$

$$\begin{array}{r} 654)7684(11\text{d.} \\ \underline{654} \end{array}$$

$$\begin{array}{r} 1144 \\ 654 \end{array}$$

$$\begin{array}{r} 490 \\ 4 \end{array}$$

$$\begin{array}{r} 654)1962(3\text{qr.} \\ \underline{1962} \end{array}$$

$$\begin{array}{r} \text{£. s. d.} \\ 5. \quad 68)132 \quad 0 \quad 8 \quad (\quad 1 \quad 18 \quad 10 \\ \underline{68} \end{array}$$

$$\begin{array}{r} 64 \\ 20 \end{array}$$

$$\begin{array}{r} 68)1280(18\text{s.} \\ \underline{68} \end{array}$$

$$\begin{array}{r} 600 \\ 544 \end{array}$$

$$\begin{array}{r} 56 \\ 12 \end{array}$$

$$\begin{array}{r} 68)680(10\text{d.} \\ \underline{68} \end{array}$$

$$0$$

Promiscuous Questions for Exercise in Compound Addition, Subtraction, Multiplication and Division.

$$\begin{array}{r} \text{Quest. 1.} \quad \text{s. d.} \\ \quad \quad \quad 2 \quad 5 \times 2 \\ \quad \quad \quad \underline{10} \\ \quad \quad \quad 1 \quad 4 \quad 2 \times 7 \\ \quad \quad \quad \underline{10} \end{array}$$

$$\begin{array}{r} 12 \quad 1 \quad 8 \\ \underline{6} \end{array}$$

$$\begin{array}{r} 72 \quad 10 \quad 0 \text{ value of 500 yards} \\ 8 \quad 9 \quad 2 \quad \text{' of 70 ' } \\ 4 \quad 10 \quad \text{' of 2 ' } \end{array}$$

$$\begin{array}{r} \text{£}81 \quad 4 \quad 0 \text{ value of 672 yards} \end{array}$$

$$\begin{array}{r} \text{T. cut. gr. lb.} \\ 3. \quad 1 \quad 2 \quad 3 \quad 16 \\ \text{Mult. by} \quad \quad \quad 8 \text{ loads} \\ \hline 9 \quad 3 \quad 0 \quad 16 \end{array}$$

$$\begin{array}{r} \text{lb. oz. dwt. gr.} \\ 2. \quad 4 \quad 1 \quad 15 \quad 22 \\ \quad \quad \quad \quad \quad \quad \quad 11 \text{ ingots} \\ \hline 45 \quad 7 \quad 15 \quad 2 \end{array}$$

$$\begin{array}{r} \text{T. cut. gr. lb.} \\ 4. \quad 8)9 \quad 3 \quad 0 \quad 16 \\ \hline 1 \quad 2 \quad 3 \quad 16 \text{ one share} \end{array}$$

Page 37.

	<i>A.</i>	<i>R.</i>	<i>P.</i>
5.	300	2	20
			5
	1503	0	20
			3
	4509	1	20

Page 38.

	<i>A.</i>	<i>R.</i>	<i>P.</i>		<i>bu.</i>	<i>d.</i>	<i>c.</i>	<i>d.</i>	<i>c.</i>	<i>m.</i>
6.	5)4509	1	20	7.	179)	201	37½	(1	12 5
	8)901	3	20			179			or 1 doll.	12½¢
	800	2	20			223				
						179				
						447				
						358				
						895				
						895				

	<i>d.</i>
8.	7×5
	10
	5 10×6
	10
	2 18 4
	3

	<i>bushels</i>
9.	1000
Mult. by	10½ cts.
	10000
	500
	\$105,00

8	15	0	in 300 days
1	15	0	60
2	11	5	

£10 12 11 in 365 days

	<i>bu.</i>	<i>d.</i>	<i>c.</i>	<i>d.</i>	<i>c.</i>		<i>£</i>	<i>s.</i>	<i>d.</i>
10.	135×2	05	=	276	75	sold for	11.	3)47	12 10½
	135×1	62½	=	219	37½	prime cost		15	17 7½
				57	37½	gain		1	15 3½

Page 38.

dolls.		dwt. gr.	
12. 9708		13. 17 8	
2		9	
5)19416		7 16 0	wt. of 9 dolls.
3883	20 eldest son.	5	
3)5824	80 rem.	oz. 39 0 0	wt. of 45 dolls.
8 1941	60 other sons, each		

oz. dwt. gr.		cwt. lb.	
14. 84 7 20		15. $2\frac{1}{2}=280$	
20		Mult. by 133	fills
150)1687	dwt. gr. gr.	837,24	
150	(11 6+8 over		
	11 6 standard		
187	0 0+8 grains over		
150			
37			
24			
148			
76			
150)908(6			
900			
8 grains			

16.	35×20 dolls. notes=	700 dolls.
	63 Eagles	=630
	284 dollars	=284
	642 half dollars	=321
	368 qr. dollars	= 92
	256×12½ cents	= 32
	Deposited Dolls.	2059
	Checks 560+820=	1380
	Dolls.	679

17. $\begin{array}{r} \text{dolls. cts.} \quad \text{dolls. cts.} \\ 36 \text{ yds. at } 4 \quad 66 = 167,76 \text{ cost} \\ \text{Add } 29.56 \text{ gained} \\ \hline \text{Must sell all for } \$197,32 \end{array}$

$\begin{array}{r} \text{dolls. cts.} \quad \text{d. c.} \\ 4 \text{ yds. at } 2 \quad 33 = 9,32 \\ 8 \text{ yds. at } 5 \quad 50 = 44,00 \\ \hline \end{array}$

12 yds. is sold for \$53,32

$\begin{array}{r} \text{dolls. cts.} \\ \text{Now, From } 36 \text{ yds. which must sell for } 197 \quad 32 \\ \text{Take } 12 \text{ yds. which brought } 53 \quad 32 \\ \hline \end{array}$

The diff. 24 yds. must sell for \$144 00

$\begin{array}{r} \text{yds. dolls.} \\ \text{But } 24) 144 \text{ (6 dollars.} \end{array}$

18. $\begin{array}{r} \text{cts.} \quad \text{d.} \quad \text{cts.} \\ 12\frac{1}{2} \times 5 = 0 \quad 62\frac{1}{2} \text{ beds.} \\ 62\frac{1}{2} \times 4 = 2 \quad 50 \text{ supper and breakfast} \\ \quad \quad \quad 75 \text{ for liquor} \\ 25 \times 5 = 1 \quad 25 \text{ for hay} \\ \hline \end{array}$

\$5 12 $\frac{1}{2}$.

From 6 dollars take \$5,12 $\frac{1}{2}$, and the remainder is 87 $\frac{1}{2}$ cts. = 875 mills

cts. ms.

But 2 $\frac{1}{2}$ = 25) 875 (35 qts. = 8 $\frac{3}{4}$ galls.

And 6 dollars \div 5 travellers = \$1,20 = 120 cents.

19. $\begin{array}{r} \text{h. m.} \quad \text{h. m. minutes} \\ 12 \quad 25 \times \text{by } 5 = 62 \quad 5 = 3725 \\ 11 \quad 30 \times \text{by } 9 = 103 \quad 50 = 6210 \\ \hline \end{array}$

Sum 9935 minutes

Now 9935 minutes

Mult. by 75 cents per day,

$\begin{array}{r} 49675 \\ 69345 \\ \hline \end{array}$

$\begin{array}{r} \text{h. mi.} \quad \text{dolls. cts. ms.} \\ \$ = 480.) 745125 \text{ (} 15 \quad 52 \quad 3+ \end{array}$

REDUCTION.

23

Page 39.

$$\begin{array}{r} \text{gal. qt. pt.} \\ 20. \quad 5)1534 \quad 1 \quad 1 \\ \hline \end{array}$$

$$\begin{array}{r} 5)306 \quad 3 \quad 1 \\ \hline \end{array}$$

$$\text{galls.} \quad 61 \quad 1 \quad 1$$

$$22. \quad A \quad 1$$

$$B \quad 2$$

$$C \quad 6$$

$$-$$

$$9$$

$$20 \times 2 = 40 \quad B's$$

$$40 \times 3 = 120 \quad C's$$

$$\begin{array}{r} \text{h. mi.} \\ 21. \quad 9)114 \quad 45 \\ \hline \end{array}$$

$$12\frac{1}{2} \quad 45\text{mins.}$$

dolls.

$$9)180$$

$$20 \quad A's \text{ share}$$

$$40 \quad B's$$

$$120 \quad C's$$

REDUCTION.

MONEY. Page 41.

$$4. \quad 4)120506 \text{ farthings}$$

$$12) \quad 30126 \quad \frac{1}{2}$$

$$2|0) \quad 251|0 \quad 6\frac{1}{2}$$

$$\pounds 125 \quad 10 \quad 6\frac{1}{2}$$

$$5. \quad 10)260 \text{ cents}$$

26 subtract

$$234 \text{ pence}$$

Page 42.

$$\begin{array}{r} \pounds \quad s. \quad d. \\ 6. \quad 480 \quad 19 \quad 9 \\ \hline \end{array}$$

$$20$$

$$9619$$

$$12$$

$$9)115437 \text{ pence}$$

$$12826\frac{1}{2} \text{ add}$$

$$128263\frac{1}{2} \text{ cents}$$

$$7. \quad 12)4658$$

$$2|0) \quad 38|8 \cdot 2$$

$$\pounds 19 \quad 8 \quad 2$$

$$8. \quad 9)648 \text{ pence}$$

$$72 \text{ add}$$

$$720 \text{ cents}$$

$$9. \quad 720 \text{ cents}$$

$$\frac{1}{16} = 72 \text{ subtract}$$

$$648 \text{ pence}$$

$$10. \quad 2)24235 \text{ half pence}$$

$$12)12117\frac{1}{2}$$

$$2|0)100|9 \quad 9\frac{1}{2}$$

$$1.50 \cdot 9 \quad 9\frac{1}{2}$$

Page 42.

11. 216 French crowns
Mult. 99 pence in a crown

1944

1944

12)21384 pence

2)0 178|2

89l. 2s.

13. 375l.

8

3)3000

\$1000

12. $\begin{matrix} \text{£.} & \text{s.} \\ 29 & 17 \end{matrix}$

20

597

12

7164

$\frac{1}{2}$ = 796 add

7960 cents

Or, 79 dolls. 60 cents

TROY WEIGHT.

1. 24 { 4)115200 grains

6)28800

2)0 480|0 (pennyweights

12)240 ounces

lb. 20

2. 30 pounds

12

360 oz.

20

7200 dwts.

24

172800 gr.

3. 2)0 4564|8 dwts.

2282oz. 8dwt.

4. $\begin{matrix} \text{lb.} & \text{oz.} & \text{dwt.} & \text{gr.} \\ 4 & 8 & 15 & 20 \end{matrix}$

12

56 ounces

20

1135 dwts.

24

4540

2272

27260 grains.

5. 24 { 4)27260 grains

6) 6815

2)0 113|5 20

12) 56 15 20

4lb. 8oz. 15dwt. 20gr.

Page 42.

	<i>dwt.</i>	<i>gr.</i>
6.	8	6
	24	
<hr/>		
	198	gr.
	24	spoons
<hr/>		
	792	
	396	
<hr/>		
	4752	grains

A VOIR DU POIS WEIGHT.

1. 3 tons
 20

 60 cwt.
 4

 240 qr.
 28

 1920
 480

 6720 lb.

2. 16 { 4) 2867200 drams
 4) 716800

 16 { 4) 179200 oz.
 4) 44800

 28) 11200 lb.

 4) 400 qr.

 20) 100 cwt.

 5 tons.

3. *Tons*
 5
 20

 100
 4

 400 gr.
 28

 11200 lb.
 16

 179200 oz.
 16

 2867200 dr.

4. *cwt. gr.*
 1 3
 4

 7
 28

 .196 lbs.
 Mult. 6 barrels

 1176 lbs.

Page 42.

	<i>cwt.</i>	<i>qr.</i>	<i>lb.</i>		<i>lb.</i>
5.	16	2	14	6.	28)2876
	4				<hr/>
	66				4) 102 20
	28				<hr/>
	532				25 <i>cwt.</i> 2 <i>qr.</i> 20 <i>lb.</i>
	133				
	1862		<i>lb.</i>		

APOTHECARIES' WEIGHT.

	<i>lb.</i>
1.	15
	12
	<hr/>
	180 oz.
	8
	<hr/>
	1440 dr.
	3
	<hr/>
	4320 scr.

Page 43.

2.	<i>lb.</i>	3.	<i>lb.</i>	4.	2 0)57600 0 grains
	3		2½		<hr/>
	12		12		3)28800 sc.
	<hr/>		<hr/>		<hr/>
	36 oz.		30		8) 9600 dr.
	8		8		<hr/>
	<hr/>		<hr/>		12)1200 oz.
	288 dr.		16)240 drams		<hr/>
	3		15 parcels		100 lb.
	<hr/>				
	864 sc.				
	20				
	<hr/>				
	17280 gr.				

CLOTH MEASURE. Page 43.

- | | |
|--|---|
| <p>1. 250 yards
 4
 <hr/> 1000 qrs.
 4
 <hr/> 4000 nails.</p> | <p>2. 4)8642 nails
 <hr/> 5)2160 2 nails
 <hr/> 432 Ells E. 2 na.</p> |
| <p>3. 324 Ells Fr.
 6
 <hr/> 4)1944 qrs.
 <hr/> 486 yards</p> | <p>4. 16 bales
 36 E. Fl.
 <hr/> 96
 48
 <hr/> 576 E. Fl.
 3
 <hr/> 4)1728 qrs.
 <hr/> 432 yards.</p> |

LONG MEASURE.

- | | |
|---|--|
| <p>1. 260 miles
 8
 <hr/> 2080
 40
 <hr/> 83200
 5½
 <hr/> 416000
 41600
 <hr/> 457600 yds.
 3
 <hr/> 1372800 feet
 12
 <hr/> 16473600 inches</p> | <p>2. <i>mi. fu. P. yds. ft.</i>
 11 7 38 2 2
 8
 <hr/> 95
 40
 <hr/> 3838
 5½
 <hr/> 19192
 1919
 <hr/> 21111
 3
 <hr/> 63335
 12
 <hr/> 760020
 3
 <hr/> 2280060 b. c.</p> |
|---|--|

3.	3) 1267200 feet	4.	<i>L. fu. yds. ft. in.</i>
	<u> </u>		3 2 110 1 5
	220) 422400 yards		3 miles
	<u> </u>		—
	3) 1920 furlongs		9
	<u> </u>		8 fur.
	60) 240 miles		—
	<u> </u>		74
	4 degrees		220 yds.
			—
			1490
			149
			—
			16390
			3
			—
			49171
			12
			—
			590057 inches

5. 360 degrees round
60 miles

21600

8 furlongs

172800

220 yards

38016000

3 feet

114048000

12 inches

1368576000

LAND MEASURE.

1. 25 acres

4

100

40

4000 perches

2. 4|0|17600|0 perches

4) 4400 roods

1100 acres

Page 43.

$$\begin{array}{r}
 3. \quad 4|00)6400|00 \text{ perches} \\
 \hline
 4|0)160|0 \text{ each share} \\
 \hline
 4) 40 \text{ roods} \\
 \hline
 10 \text{ acres}
 \end{array}$$

$$\begin{array}{r}
 4. \quad 10 \text{ acres} \\
 160 \\
 \hline
 1600 \text{ perches} \\
 30\frac{1}{2} \\
 \hline
 48000 \\
 400 \\
 \hline
 48400 \text{ yards} \\
 9 \\
 \hline
 435600 \text{ feet} \\
 144 \\
 \hline
 62726400 \text{ inches}
 \end{array}$$

CUBIC, OR SOLID MEASURE.

$$1. \quad \begin{array}{c} \text{ft.} \\ 128 \end{array}) \begin{array}{c} \text{feet.} \\ 3200 \end{array} (25 \text{ cords}$$

Page 44.

$$2. \quad \begin{array}{c} \text{ton.} \\ 20 \end{array} \times \begin{array}{c} \text{ft.} \\ 50 \end{array} = \begin{array}{c} \text{feet.} \\ 1000 \end{array}$$

$$3. \quad \begin{array}{c} \text{ton.} \\ 50 \end{array} \times \begin{array}{c} \text{ft.} \\ 40 \end{array} \times \begin{array}{c} \text{cu. in.} \\ 1728 \end{array} = \begin{array}{c} \text{cu. in.} \\ 2073600 \end{array}$$

TIME.

$$\begin{array}{r}
 1. \quad \begin{array}{c} w. \quad d. \quad h. \quad m. \\ 8 \quad 2 \quad 6 \quad 20 \\ 7 \\ \hline 58 \\ 24 \\ \hline 238 \\ 116 \\ \hline 1398 \\ 60 \\ \hline 83900 \text{ min.} \end{array}
 \end{array}$$

$$\begin{array}{r}
 2. \quad \begin{array}{c} da. \quad h. \\ 365 \quad 6 \text{ in one year} \\ 24 \\ \hline 1466 \\ 730 \\ \hline 8766 \\ 60 \\ \hline 525960 \\ 60 \\ \hline 31557600 \text{ sec.} \\ 10 \text{ years} \\ \hline 315576000 \end{array}
 \end{array}$$

Page 45.

$$3. \quad \begin{array}{c} \text{yrs.} \\ 1823 \end{array} \times \begin{array}{c} \text{days} \\ 365\frac{1}{4} \end{array} = \begin{array}{c} \text{days} \\ 665850 \end{array} \quad \begin{array}{c} \text{hrs.} \\ 18 \end{array}$$

$$\begin{array}{r}
 4. \quad \begin{array}{c} w. \quad da. \quad hr. \quad mi. \quad sec. \\ 1 \times 7 \times 24 \times 60 \times 60 = 604800 \text{ sec.} \end{array} \\
 3^*
 \end{array}$$

LIQUID MEASURE. Page 45.

$$\begin{array}{r}
 1. \quad 4 \text{ tuns} \\
 \quad 4 \\
 \hline
 \quad 16 \text{ hhd.} \\
 \quad 63 \\
 \hline
 \quad 1008 \text{ galls} \\
 \quad 8 \\
 \hline
 \quad 8064 \text{ pints}
 \end{array}$$

$$\begin{array}{r}
 2. \quad \text{pints.} \\
 \quad 8)4032 \\
 \hline
 \quad 63) 504 \text{ galls.} \\
 \hline
 \quad 8 \text{ hhd.}
 \end{array}$$

$$\begin{array}{r}
 \text{hhd gal. pt.} \\
 3. \quad 38 \times 63 \times 8 = 19152 \text{ pints}
 \end{array}$$

DRY MEASURE.

$$\begin{array}{r}
 1. \quad 78 \text{ bu. } 3 \text{ pc. } 7 \text{ qt.} \\
 \quad 4 \\
 \hline
 \quad 315 \\
 \quad 8 \\
 \hline
 \quad 2527 \\
 \quad 2 \\
 \hline
 \quad 5054 \text{ pints}
 \end{array}$$

$$\begin{array}{r}
 2. \quad 2)2196 \\
 \hline
 \quad 8) 1098 \\
 \hline
 \quad 4) 137 \text{ 2} \\
 \hline
 \quad 34 \text{ bu. } 1 \text{ pc. } 2 \text{ qt.}
 \end{array}$$

ADDITION OF DECIMALS.

Page 47.

$$2. \quad \text{Ans. } 3923400,3687078$$

$$\begin{array}{r}
 3. \quad 283,604 \\
 \quad 490006,003275 \\
 \quad 21,05 \\
 \quad 1,2 \\
 \quad 6200,3476 \\
 \hline
 \text{Sum } 496512,204875
 \end{array}$$

$$\begin{array}{r}
 4. \quad ,246 \\
 \quad ,012 \\
 \quad ,02 \\
 \quad ,6 \\
 \quad ,413 \\
 \quad ,5 \\
 \hline
 \text{Sum } 1,791
 \end{array}$$

$$\begin{array}{r}
 5. \quad 25,52 \\
 \quad 225,005 \\
 \quad ,0035 \\
 \quad 844, \\
 \quad 2,2 \\
 \quad 300,825 \\
 \quad ,00005 \\
 \hline
 \text{Sum } 1397,55355
 \end{array}$$

$$\begin{array}{r}
 6. \quad 125,5 \\
 \quad 1000,900005 \\
 \quad 15,072 \\
 \quad 2,01 \\
 \hline
 \text{Sum } 10142,582005
 \end{array}$$

$$\begin{array}{r}
 7. \quad 5,4 \\
 \quad 15,04 \\
 \quad 100,004 \\
 \quad 6000,00004 \\
 \quad 93880,0004 \\
 \hline
 \text{Sum } 100000,44444
 \end{array}$$

SUBTRACTION OF DECIMALS.

Page 47.

2. Ans. 685,495632

3. Ans. 8,3047

$$\begin{array}{r}
 4. \text{ From } 45,005 \\
 \text{Take } 23,65482 \\
 \hline
 \text{Diff. } 21,35018
 \end{array}$$

$$\begin{array}{r}
 5. \text{ From } 620,2 \\
 \text{Take } 200,002 \\
 \hline
 \text{Diff. } 420,198
 \end{array}$$

Page 48.

$$\begin{array}{r}
 6. \text{ From } 5, \\
 \text{Take } ,10438 \\
 \hline
 4,89562
 \end{array}$$

$$\begin{array}{r}
 7. \text{ From } 2, \\
 \text{Take } ,00002 \\
 \hline
 1,99998
 \end{array}$$

$$\begin{array}{r}
 8. \text{ From } 16, \\
 \text{Take } ,016 \\
 \hline
 15,984
 \end{array}$$

MULTIPLICATION OF DECIMALS.

$$\begin{array}{r}
 4. \text{ Mult. } ,385746 \\
 \text{by } ,00463 \\
 \hline
 1157238 \\
 2314476 \\
 1542984 \\
 \hline
 ,00178600398
 \end{array}$$

$$\begin{array}{r}
 5. \text{ Mult. } 158,694 \\
 \text{by } 23,15 \\
 \hline
 793470 \\
 158694 \\
 476082 \\
 317388 \\
 \hline
 3673,76610
 \end{array}$$

$$\begin{array}{r}
 6. \text{ Mult. } ,024653 \\
 ,00022 \\
 \hline
 49306 \\
 49306 \\
 \hline
 ,00000542366
 \end{array}$$

$$\begin{array}{r}
 7. \text{ Mult. } 25,04 \\
 ,002 \\
 \hline
 ,05008
 \end{array}$$

$$\begin{array}{r}
 8. \text{ Mult. } 645,003 \\
 ,000005 \\
 \hline
 ,003225015
 \end{array}$$

Contraction in Multiplication of Decimals.

Page 50.

$$\begin{array}{r}
 3. \text{ 23,463 multiplicand} \\
 \text{43,2 multiplier reversed} \\
 \hline
 46926 \\
 7039 \\
 938 \\
 \hline
 54,903
 \end{array}$$

$$\begin{array}{r}
 5. \text{ 3,141592 multiplicand} \\
 \text{8347,25 mult. rev.} \\
 \hline
 1570796 \\
 62832 \\
 21991 \\
 1257 \\
 94 \\
 25 \\
 \hline
 165,6995
 \end{array}$$

$$\begin{array}{r}
 4. \text{ 234,216 mult.} \\
 \text{543,2 mult. rev.} \\
 \hline
 46343 \\
 7026 \\
 937 \\
 117 \\
 \hline
 549,23
 \end{array}$$

DIVISION OF DECIMALS.

Page 50.

$$3. \quad 23,7)65321,0(2756,16$$

474

1792

1659

1331

1185

1460

1422

380

237

1430

1422

8 rem.

$$4. \quad 64,25)234,70525(3,653$$

19275

41955

38550

34052

32125

19275

19275

$$5. \quad 3)10,$$

3,3333 $\frac{1}{3}$

$$6. \quad ,9)9,0$$

10

$$7. \quad ,00463),00178600398(,385746$$

1389

3970

3704

2660

2315

3453

3241

2129

1852

2778

2778

Page 51.

$$8. \quad 2,46)2327898(,09463$$

2214

1138

984

1549

1476

738

738

$$9. \quad ,00463)2327898(2,46$$

18926

43529

37852

56778

56778

Page 51.

$$10. \quad ,018),000162(,009 \\ \underline{162}$$

Contraction in Division of Decimals.

Page 52.

$4. \quad 1,346787)74,33373(55,193$ $\begin{array}{r} 67339 \\ \hline 6994 \\ 6734 \\ \hline 260 \\ 135 \\ \hline 125 \\ 121 \\ \hline 4 \\ 4 \end{array}$	$5. \quad 9,365407)87,076326(9,297$ $\begin{array}{r} 84289 \\ \hline 2787 \\ 1873 \\ \hline 914 \\ 843 \\ \hline 71 \\ 65 \\ \hline 6 \end{array}$
--	---

$$6. \quad 2,45)32,68744231(13,34$$

$$\begin{array}{r} 245 \\ \hline 818 \\ 735 \\ \hline 85 \\ 73 \\ \hline 10 \\ 10 \end{array}$$

$$7. \quad 6,24),0046872345(,00075$$

$$\begin{array}{r} 437 \\ \hline 31 \\ 31 \\ \hline 0 \end{array}$$

REDUCTION OF DECIMALS.

Case 1. Page 53.

$$2. \quad 2)1,0(,5 \qquad 3. \quad 4)3,00(,75$$

Page 53.

4. $8)7,000(,875$

5. $25)1,00(,04$

6. $60)57,00(,95$

7. $15)6,00(,40 \text{ cents}$

Case 2.

2. $\begin{array}{r} \text{s.} \\ 19 \div 20 = 95 \end{array}$

3. $\begin{array}{r} \text{d.} \\ 3 \div 12 = ,25 \end{array}$

4. $\begin{array}{r} \text{d.} \\ 3 \div (12 \times 20) = ,0125 \end{array}$

5. $\begin{array}{r} \text{£.} \\ 4 \text{ } 2 = 18 \div (20 \times 4) = 225 \text{ ton} \end{array}$

6. $\begin{array}{r} \text{qr. lb. lb.} \\ 2 \text{ } 14 = 70 \div (28 \times 4) = ,625 \text{ cwt.} \end{array}$

7. $\begin{array}{r} \text{qr. na. na.} \\ 3 \text{ } 3 = 15 \div (4 \times 4) = ,9375 \text{ yds.} \end{array}$

Or thus,

5. $\begin{array}{r} \text{qr.} \ 4 \ | \ 2, \\ \text{cwt.} \ 20 \ | \ 4,5 \\ \hline \end{array}$

6. $\begin{array}{r} \text{lb.} \ 28 \ | \ 14 \\ \text{ } \ 4 \ | \ 2,5 \\ \hline \end{array}$

7. $\begin{array}{r} \text{na.} \ 4 \ | \ 3 \\ \text{qr.} \ 4 \ | \ 3,75 \\ \hline \end{array}$

,225 ton.

cwt. ,625

yds. ,9375

Case 3. Page 54.

2. $\begin{array}{r} \text{£.} \\ ,75 \\ 20 \\ \hline \end{array}$
shillings 15,00
 \hline
15 s.

3. $\begin{array}{r} \text{lb.} \\ ,7 \\ 12 \\ \hline \end{array}$
ounces 8,4
 \hline
20

dwts. 8,0 8oz. 8dwts.

4. $\begin{array}{r} ,617 \text{ cwt.} \\ 4 \\ \hline \end{array}$

qr. $\begin{array}{r} 2,468 \\ 28 \\ \hline \end{array}$

lb. $\begin{array}{r} 13,104 \\ 16 \\ \hline \end{array}$

oz. $\begin{array}{r} 1,664 \\ 16 \\ \hline \end{array}$

dr. 10,624

2 qr. 13 lb. 1 oz. 10 dr.

5. $\begin{array}{r} ,3375 \text{ acres} \\ 4 \\ \hline \end{array}$

rood. $\begin{array}{r} 1,3500 \\ 40 \\ \hline \end{array}$

per. 14,0000

1 rood 14 per.

Page 54.

6. *min.*
 ,258
 4

 hhd. 1,032
 63

 gal. 2,016

 1 hhd. 2 gal.

7. *days.*
 ,761
 24

 hrs. 18,264
 60

 mi. 15,840
 60

 sec. 50,400

18 hr. 15 mi. 50,4 sec.

8. *lb.*
 ,7
 12

 oz. 8,4
 20

 dwt. 8,0

 8 oz. 8 dwt.

9. 365,25 days in a year
 ,3

 days 109,575
 24

 hrs. 13,800
 60

 min. 48,000

 109 d. 13 h. 48 m.

10. *day hr. hours*
 ,41 $\times 24 = 9,84$
 ,16

 hrs. 9,68
 60

 min. 40,80
 60

 sec. 48,00

 9 h. 40 m. 48 sec.

11. *T. cwt. qr. lb.*
 ,17 ,19 ,17 ,7
 20

 cwt. 3,59
 4

 2,53
 28

 15,54

 Scwt. 2qr. 15,54lb.

Promiscuous Questions in Decimal Fractions

Page 55.

Quest. 1. Mult. .09
by ,009

Prod. ,00081

3. ,9125 ounces
20

dwt. 18,2500
24

gr. 6,0000

18 dwt. 6 gr.

2. ,36 ton
20
7,20 cwt.
4

28,80 qr.
28

23040
5760

806,40 lb.
16

12902,40 oz.

4. 315)4,00(,0127 nearly

oz. dwt. gr.

5. 2 16 20=1364 grains

And 1 pound=5760 grains

Then, 5760)1364,0(,2368

6. ^{miles}
,1392
8

fur. 1,1136
40

per. 4,5440
5½

27200
2720

yds. 2,9920
1 fur. 4 per. 3 yds.

11. 1 doll.=100 cts.

3

15)300

6) 20

6½ cents

7. 4)3,00(,75

8. 112)6,00(,0535714

9. 365)109,5(,3

10. ,04×50×1728=\$456

12. ^{hds.}
,875
63

2625
5250

gall. 55,125
4

qt. ,500
2

pt. 1,000

55 gal. 1 pint

12. 222)1,000(,004504

Page 55.

14. 365,25 days in a year
 ,05

 18,2625
 24

 730500
 365250

 438,3000 hr.
 60

 26298,0 mi.
 60

 1577880 sec.
15. ,73 ÷ (3 × ,25) that is
 ,75),73(,973½
 16. *yr. w. d. h. mi.*
 ,05 = 2 2 19 12
 hr.
 ,5 = 0 0 0 30

 2w. 2d. 18h. 42mi.*

 18. *A. R. P.*
 ,6 × 4 × 40 × ,02 = 1,92

 17. *T. h. gal.*
 ,4 ,3 ,8
 4
 1,9
 63

 120,5 gall.

 482,0 qt.
 2

 964 pints

 19. *cub.in. ft. in.*
 1 ÷ (128 × 1728) that is
 221184)1,000000(,000004+

 20. (28 deg. 48 min.) ÷ 360 deg.
 that is,
 mi. mi.
 21600)1728,00(,08

SINGLE RULE OF THREE DIRECT.

Page 57.

Quest. 2. As 112 : 12,32 :: 16 : $\frac{12,32 \times 16}{112} = 1 \text{ d. } 76 \text{ c.}$

3. As 1 : 36 :: 336 (=3) : 120 dolls. 96 cts.

4. *yds. yds. yds. yds. yds.*
 23 + 24 + 25 + 27 = 99 then

yd. cts. yds.
 As 1 : 72 :: 99 : 99 × 72 = 71 dolls. 28 cts.

* This answer is obtained by reckoning 12 months to the year, 4 weeks to the month, 7 days to a week, &c. But at 52 weeks to the year, the answer will be 2w. 4d. 4h. 18mi. And at 365½ days, it will be 2w. 4d. 5h. 48mi. the true Answer.

Page 57.

$$5. \text{ As } \begin{matrix} \text{lb.} & \text{cts.} & \text{lb.} \\ 4 & : 48 & :: 512 \end{matrix} (4 \text{ cwt. } 2 \text{ qr. } 8 \text{ lb.}) : 61 \text{ dolls. } 44 \text{ cts.}$$

$$6. \text{ As } \begin{matrix} \text{lb.} & \text{cts.} & \text{lb.} \\ 1 & : 8 & :: 128 \end{matrix} : 10 \text{ dolls. } 24 \text{ cts.}$$

$$7. \text{ As } \begin{matrix} \text{pair} & & \text{d. c.} & \text{pair} \\ 114 (=9\frac{1}{2} \text{ doz.}) & : 68,40 & :: 3 & : 1 \text{ doll. } 80 \text{ cts.} \end{matrix}$$

$$8. \text{ As } \begin{matrix} \text{bu.} & \text{d. c.} & \text{bu.} \\ 20 & : 9,60 & :: 3 & : 1 \text{ doll. } 44 \text{ cts.} \end{matrix}$$

$$9. \text{ As } \begin{matrix} \text{cts.} & \text{yd.} & \text{d. cts.} \\ 75 & : 1 & :: 16,50 & : 22 \text{ yards.} \end{matrix}$$

$$10. \text{ As } \begin{matrix} \text{c. qr. lb.} & \text{d. cts.} & \text{oz. cts.} \\ 32080 (=17 \text{ } 3 \text{ } 17) & : 320,80 & :: 6 & : 6 \end{matrix}$$

Page 58.

$$11. \text{ As } \begin{matrix} \text{oz.} & \text{lb.} & \text{dol.} & \text{oz.} & \text{d. c.} \\ 116,4 (=9,7) & : 97 & :: 1,5 & : \frac{97 \times 1,5}{9,7 \times 12} = 1 \end{matrix} 25$$

$$12. \text{ As } \begin{matrix} \text{acres} & \text{dolls.} & \text{acres} \\ 125,5 & : 627,5 & :: 1 & : 5 & :: 4,75 & : 23 \text{ doll. } 75 \text{ cents.} \end{matrix}$$

$$13. \text{ As } \begin{matrix} \text{gal. dolls. cts.} & \text{gal.} \\ 1,5 & : 4 \text{ } 50 & :: 378 (=1,5 \text{ tuns}) & : 1134 \text{ dolls.} \end{matrix}$$

$$14. \text{ First } \begin{matrix} \text{d. cts.} & \text{d. cts.} & \text{d. cts.} & \text{d. cts.} \\ 1 & 66+1 & 97+2 & 31=5 \end{matrix} 94 \text{ the price of 1 ream of each sort. Then say—}$$

$$\text{As } \begin{matrix} \text{d. cts. of each sort.} & \text{d. cts.} \\ 5 & 94 & : 1 & :: 528 & 66 & : 89 \text{ reams of each sort.} \end{matrix}$$

$$15. \text{ As } \begin{matrix} \text{lb.} & \text{T.} & \text{d.} & \text{lb.} & \text{qr. lb.} \\ 2240 (=1) & : 224 & :: 42 (=1 \text{ } 14) & : 4 \text{ dolls } 20 \text{ cts.} \end{matrix}$$

$$16. \text{ As } \begin{matrix} \text{d. c.} & \text{bbl.} & \text{d. c.} \\ 5 & 50 & : 1 & :: 1402,50 & : 255 \text{ barrels} \end{matrix}$$

$$17. \text{ As } \begin{matrix} \text{da.} & \text{d. cts.} & \text{da.} \\ 365 & : 1186,25 & :: 1 & : 3 \text{ dolls. } 25 \text{ cents.} \end{matrix}$$

Page 58.

18. $\begin{matrix} da. & d. & cts. & da. \end{matrix}$
 As 1 : 2 25 :: 365 : 821 dolls. 25 cents, the
 sum he spends in a year.

Now, 821 dol. 25 cts. + 378 dol. 75 cts. = 1200 dolls.

19. $\begin{matrix} T. & cwt. & qr. & lb. & lb. \end{matrix}$
 4 10 1 12 = 10120

Then, as $\begin{matrix} lb. & cts. & lb. \end{matrix}$ 112 : 1,12 :: 10120 : 101 dolls. 20 cents

20. 4 ft. 6 in. = 54 inches
 $\frac{1}{2}$ of 54 = 27 add

81
 27

 2187
 9

19683 solid inches

Then, as $\begin{matrix} cu. in. & cts. & cu. in. \end{matrix}$ 1728 : 110 :: 19683 : 12 dolls. 53 cts. nearly

21. $\begin{matrix} in. & in. & in. & in. \end{matrix}$
 (28 + 14) × 14 × 3,5 = 2058 cubic inches

Then, as $\begin{matrix} cu. in. & cts. & cu. in. & d. & cts. & m. \end{matrix}$ 1728 : 190 :: 2058 : 2 26 $\frac{2}{3}$ +

22. $\begin{matrix} £. & s. & s. & T. & cwt. & qr. & lb. & lb. \end{matrix}$
 One ton = 2240 lb. 22 8 = 448 & 203 9 3 3 = 455815

Now, as $\begin{matrix} lb. & s. & lb. & s. \end{matrix}$ 2240 : 448 :: 5 : 1 :: 455815 : 91163 = £4558 3s.

23. $\begin{matrix} d. & cts. & yds. \end{matrix}$ As 11 25 : 5 that is, as 225 : 1 :: $\begin{matrix} d. & cts. & yds. \end{matrix}$ 850 50 : 378 in all
 And, as 18 pieces : 378 yds. :: 1 piece : 21 yards

24. $\begin{matrix} hf. & yds. & yds. & d. & £. & s. & d. & hf. & yds. & d. & s. \end{matrix}$
 As 25 (= 12 $\frac{1}{2}$) : 450 (= 1 17 6) :: 2 : 36 = 3

25. $\begin{matrix} ft. & ft. & ft. & in. \end{matrix}$
 As 7 : 4 :: 218 9 : 125 feet

Page 58.

A. R. P.

26. 476 3 28=76308 perches. Then say

P. d. c. P.

As 76308 : 4292 32½ :: 160 : 9 dollars

da. cts. du. d. cts.

27. As 1 : 214 :: 365 : 781 10 spends

dolls. cts.

Then, from 1333 00 annual income

take 781 10 yearly expense

\$551 90 he will save

Page 59.

bu. d. c. bu.

28. As 321 : 240,75 :: 1 : 75 cents

na. yds. cts. na. qr. na.

29. As 24(=1½) : 250 :: 8(=1 2) : 62½ cents

gal. gal. gal.

30. 120½+124+126¾=371¼ gallons

gal. d. s. d. gal. pence £. s. d.

As 1 : 66(=5 6) :: 371¼ : 24502½=102 1 10½

mi. da. mi.

31. 12×5=60 the distance that A has gone before B starts

mi. mi.

16—12=4 miles B gains on A per day

mi. da. mi.

Then, as 4 : 1 :: 60 : 15 days

£. d. s. d. £. pence £.

32. As 1 : 150(=12 6) :: 1000 : 150000=625

men bbls. men bbls. bbls.

33. As 365 : 75 :: 500 : 102½⅞=102½⅞

34. This is properly a question belonging to the rule of Three Inverse, stated thus,

cts. A. cts.

As 375 : 360 :: 250 then,

cts. A. $\frac{375 \times 360}{250 \text{ cts.}} = 540 \text{ acres.}$

Page 59.

$$\text{S5. As } 1440(=24) : 25020(=360 \times 69\frac{1}{2}) :: 1 : 17 \text{ } 3$$

SINGLE RULE OF THREE INVERSE.

Page 60.

$$\text{Quest. 2. As } 60 : 100 :: 20, \quad 3. \text{ As } 65 : 4 :: 5$$

$$\begin{array}{r} 60 \\ 2|0)600|0 \\ \hline \end{array}$$

300 days

$$\begin{array}{r} 4 \\ 5)260 \\ \hline \end{array}$$

52 days

$$4. \text{ As } 6 : 24 :: 9 (=6+3) : \frac{6 \times 24}{9} = 16 \text{ days}$$

$$5. \text{ As } 1 : 150 :: 6 : \frac{1 \times 150}{6} = 25 \text{ miles}$$

$$6. \text{ As } 80 : 300 :: 60 : \frac{80 \times 300}{60} = 400 \text{ yards}$$

$$7. \text{ As } 80 : 30 :: 70 : \frac{80 \times 30}{70} = \frac{8 \times 30}{7} = 34r. 4ft. 8\frac{4}{7}in.$$

$$8. \text{ As } 1 : 12 :: ,75 : \frac{12,00}{,75} = 16 \text{ feet}$$

$$9. \text{ As } ,75 : 42,5 :: 1,25 : \frac{,75 \times 42,5}{1,25} = 25,5 \text{ yards}$$

$$10. \text{ As } 10 : 4,5 :: 15 (=10+5) : \frac{10 \times 4,5}{15} = 3 \text{ months}$$

$$11. \text{ As } 80 : 15 :: 600 : \frac{80 \times 15}{600} = 2 \text{ years.}$$

$$12. \text{ As } 12 : 4 :: 16 : \frac{12 \times 4}{16} = 3 \text{ days}$$

$$13. \text{ As } 30 : 400 :: 50 : \frac{30 \times 400}{50} = 240 \text{ the number of}$$

men the provisions will serve fifty days

men men

And $400 - 240 = 160$ men must depart.

Page 61.

$$14. \text{ As } \overset{\text{dolls.}}{292} : \overset{\text{mo.}}{6} :: \overset{\text{dolls.}}{806} : \frac{292 \times 6}{806} = 2\text{mo. } 5\frac{1}{2}\text{da.}$$

$$15. \text{ As } \overset{\text{men}}{1200} : \overset{\text{mo.}}{9} :: \overset{\text{men}}{1600} (=1200+400) : \frac{1200 \times 9}{1600} = 6\frac{1}{2}\text{mo.}$$

Again,

$$\text{As } \overset{\text{men}}{1200} : \overset{\text{oz.}}{14} :: \overset{\text{men}}{1600} : \frac{1200 \times 14}{1600} = 10\frac{1}{2}\text{ allowance per day}$$

And $14\text{oz.} - 10\frac{1}{2}\text{oz.} = 3\frac{1}{2}\text{oz.}$ diminution required.

$$16. \text{ As } \overset{\text{rod.}}{40} : \overset{\text{rod.}}{4} :: \overset{\text{rod.}}{25} : \frac{40 \times 4}{25} = 6\frac{2}{5}\text{ rods.}$$

$$17. \text{ As } \overset{\text{in.}}{12} : \overset{\text{in.}}{12} :: \overset{\text{in.}}{3} : \frac{12 \times 12}{3} = 48\text{ inches.}$$

$$18. \text{ As } \overset{\text{cws.}}{6} : \overset{\text{days}}{91} :: \overset{\text{cws.}}{21} : \frac{6 \times 91}{21} = 26\text{ days.}$$

$$19. \text{ As } \overset{\text{mi.}}{600} (=10) : \overset{\text{hrs.}}{1} :: \overset{\text{pipe}}{24} : \frac{600}{24} = 25\text{ pipes}$$

$$20. \text{ As } \overset{\text{inches}}{216} (=18) : \overset{\text{ft.}}{10} (=30) :: \overset{\text{yd.}}{18} (= \frac{1}{4}) : \frac{216 \times 10}{18} = 120\text{yds.}$$

$$21. \text{ As } \overset{\text{in.}}{75} (= \frac{3}{4}) : \overset{\text{lb.}}{208} :: \overset{\text{m.}}{39} : \frac{75 \times 208}{39} = 4\text{lb.}$$

da. mi. mi.

$$22. 5 \times 20 = 100 \text{ A has gone before B starts.}$$

mi. mi.

$$25 - 20 = 5 \text{ miles B gains on A each day.}$$

*mi. da. mi. da.*Now, as $5 : 1 :: 100 : 20$ B will overtake A.*da. mi. mi.*And $20 \times 25 = 500$ the distance B must travel.

GENERAL RULE.

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Quest. 3. As $\overset{\text{mo.}}{5} : \overset{\text{mo.}}{2} :: \overset{\text{men}}{800} : \frac{800 \times 2}{5} = 320$ the number of men the provisions will serve for five months.

Then, $800 \text{ men} - 320 \text{ men} = 480 \text{ men}$ must depart.

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$$\begin{array}{c} \text{galls.} \quad \text{galls.} \quad \text{galls.} \\ 4. \quad 63 - 9 = 54 \text{ remains} \end{array}$$

$$\begin{array}{c} \text{dolls.} \quad \text{dolls.} \quad \text{dolls.} \\ \text{And } 119 + 12 = 131 \text{ must sell for} \end{array}$$

$$\begin{array}{c} \text{gal.} \quad \text{gal.} \quad \text{dol.} \quad \text{d.} \quad \text{c.} \quad \text{m.} \\ \text{Then, as } 54 : 1 :: 131 : \frac{131}{54} = 2 \text{ } 42 \text{ } 5\frac{1}{2} \end{array}$$

$$\begin{array}{c} \text{mi.} \quad \text{mi.} \quad \text{lb.} \quad \text{lb.} \\ 5. \text{ As } 64 : 512 \text{ that is, as } 1 : 8 :: 225 : 1800 \end{array}$$

$$\begin{array}{c} \text{dolls.} \quad \text{dolls.} \quad \text{cts.} \quad \text{cts.} \\ 6. \text{ As } 1750 : 10 :: 175 : 1 :: 8750 : 50 \end{array}$$

Promiscuous Questions in Direct and Inverse Proportion.

$$\begin{array}{c} \frac{1}{2} \text{mi.} \quad \text{mi.} \quad \text{hr.} \quad \frac{1}{2} \text{mi.} \quad \text{mi.} \quad \text{hr.} \quad \text{mi.} \\ \text{Quest. 1. As } 5 (=2\frac{1}{2}) : 1 :: 246 (=123) : 49 \text{ } 12 \text{ going} \end{array}$$

$$\begin{array}{c} \frac{1}{2} \text{mi.} \quad \text{mi.} \quad \text{hr.} \quad \frac{1}{2} \text{mi.} \quad \text{hrs.} \quad \text{mi.} \quad \text{sec.} \\ \text{And, as } 7 (=3\frac{1}{2}) : 1 :: 246 : 35 \text{ } 8 \text{ } 34\frac{2}{3} \text{ returning} \end{array}$$

$$\begin{array}{r} \text{hrs.} \quad \text{mi.} \quad \text{sec.} \\ \text{But } 49 \quad 12 \quad 0 \\ \quad 35 \quad 8 \quad 34\frac{2}{3} \\ \hline \end{array}$$

$$\text{Sum } 84\text{h. } 20\text{mi. } 34\frac{2}{3}\text{sec.}$$

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$$\begin{array}{c} \text{dolls.} \quad \text{da.} \quad \text{dolls.} \\ \text{Quest. 2. Stated thus, as } 1000 : 189 :: 650 \text{ Inverse pro.} \end{array}$$

$$\begin{array}{c} \text{dolls.} \quad \text{dolls.} \quad \text{days.} \\ \text{Or, as } 650 : 1000 :: 189 \text{ by the general rule.} \end{array}$$

$$\begin{array}{c} \text{dolls.} \quad \text{da.} \quad \text{da.} \\ \text{Then } \frac{1000 \times 189}{650 \text{ dolls.}} = \frac{20 \times 189}{13} = 290\frac{10}{13} \text{ days.} \end{array}$$

$$\begin{array}{c} \text{cwt.} \quad \text{qr.} \quad \text{lb.} \quad \text{casks} \quad \text{lb.} \quad \text{cwt.} \quad \text{lb.} \quad \text{cwt.} \quad \text{lb.} \\ 3. \quad (1 \quad 1 \quad 4) \times 14 = 144 \times 14 = 2016 \quad 1 = 112 \end{array}$$

$$\begin{array}{c} \text{lbs.} \quad \text{cts.} \quad \text{lbs} \\ \text{Then, as } 112 : 1260 :: 2016 : \frac{12,60 \times 2016}{112} = 226\text{d. } 80\text{c.} \end{array}$$

$$\begin{array}{c} \text{lbs.} \quad \text{cts.} \quad \text{lb.} \\ \text{And, as } 112 : 1260 :: 1 : \frac{1260}{112} = \frac{45}{4} = 11 \text{ cts. } 2\frac{1}{2} \text{ ms.} \end{array}$$

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- cwt. qr. lb. chests lb. chest. lb.*
 4. (1 0 14) $\times 4 = 126 \times 4 = 504$ the whole weight.

			<i>dolls. cts.</i>
Now, as 1 lb. :	80 cts. ::	126 lb. :	100 80
1 lb. :	90 cts. ::	126 lb. :	113 40
1 lb. :	105 cts. ::	126 lb. :	132 30
1 lb. :	125 cts. ::	126 lb. :	157 50

\$504 00 the amt.

Then, as 504 lb. : 504 dolls. :: 1 lb. : 1 dollar

5. 5oz. $\times 12 = 60$ ounces of bread in a dozen of rolls.

And, as 5 : 4 :: 60oz. : 48oz. the weight of flour in a dozen of rolls.

<i>oz. cwt. dolls.</i>	<i>oz.</i>
Then, as 1792 (=1) :	224 .. 8 : 1 :: 48 : 6 cts.

	<i>dolls. cts.</i>
6. Cost	780 00
Freight	37 70
Other charges	30 60
Gain	143 00

\$991 30 cts. must sell the whole for

<i>ddl. dolls. cts. ddl.</i>
Then, as 270 : 991 30 :: 1 : 3 dolls. 67 $\frac{4}{17}$ cts.

7. Half a ton = 10 cwt. = 40 qrs.

As $\frac{\text{horses}}{80} : \frac{\text{qrs.}}{40} :: \frac{\text{horses}}{7} : \frac{40 \times 7}{80} = \frac{7}{2} = 3\text{qrs. } 14 \text{ lb.}$

Quest. 8. 12ft. = 144 inches, and 9ft. 3in. = 111 inches, 144in. \times 111 in. = 15984 inches. In that distance the large wheel will have made 111 revolutions and the smaller 144 turns. But 144—111 = 33 turns of the less more than the greater in that distance. Now, as 33 turns : 15984 inches distance :: 1000 turns : 484363 $\frac{7}{11}$ inches; this, when reduced to miles, is 7 miles, 5 furlongs, 34 yards, 1 foot, 7 $\frac{7}{11}$ inches.

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Quest. 9. This question being inverse, say

$$\text{As } \overset{\text{hrs.}}{15} : \overset{\text{da.}}{18} :: \overset{\text{hrs.}}{12} : \frac{15 \times 18}{12} = \frac{15 \times 3}{2} = 22\frac{1}{2} \text{ days.}$$

10. $\overset{\text{yds.}}{42,5} : \overset{\text{dolls. cts.}}{191,25} :: 1 : 4,5 :: \overset{\text{yds.}}{15} : 67 \text{ dolls. } 50$
 cts. what 15 yards cost; but $\frac{2}{3}$ of 67 dolls. 50 cts. = 45 dolls.
 the amount that 15 yards sells for.

Now, $42\frac{1}{2}$ yards at 1 dollar, comes to 42 dollars 50 cents,
 whole gain.

$$\begin{array}{r} \overset{\text{d.}}{191} \overset{\text{cts.}}{25} + \overset{\text{d.}}{42} \overset{\text{cts.}}{50} = 233,75 \text{ must get in all} \\ \text{Subtract } 45,00 \text{ received for 15 yards.} \end{array}$$

Diff. \$188,75 the sum that the remaining
 $27\frac{1}{2}$ yards must bring. But

$$\overset{\text{yds.}}{\text{As } 27,5} : \overset{\text{d. c.}}{188,75} :: 1 : 6,86\frac{4}{11}$$

11. State by the general rule

$$\overset{\text{yds.}}{\text{As } 60} : \overset{\text{yds.}}{10} (=30) :: \overset{\text{ft.}}{6} : 1 :: \overset{\text{ft.}}{18} : 3 \text{ feet}$$

$$\overset{\text{rod.}}{\text{As } 40} : \overset{\text{rod.}}{640} (=160 \times 4) :: \overset{\text{rod. A.}}{1} : \overset{\text{rod. rods.}}{16}$$

$$\text{Or, } \overset{\text{rod.}}{\text{As } 40} : \overset{\text{rod.}}{160} :: \overset{\text{rod. rods.}}{1} : 4 :: 4 : 16$$

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13. Because the large wheel has 70 cogs, and the small
 one 52, the small wheel will make 70 revolutions while the
 large ones makes 52. But $70 - 52 = 18$ revolutions that the
 small wheel will gain in the same time. But

$$\text{As } \overset{\text{rev.}}{18} : \overset{\text{rev.}}{52} :: \overset{\text{rev.}}{100} : \frac{52 \times 100}{18} = 288\frac{8}{9} \text{ revolutions.}$$

$$\overset{\text{feet.}}{1142} \times \overset{\text{sec.}}{60} = 68520 \text{ the dist. sound goes in a minute.}$$

$$\text{Then, as } \overset{\text{pul.}}{70} : \overset{\text{feet}}{68520} :: \overset{\text{pul.}}{20} : 19577\frac{1}{4} = 3 \text{ } 5 \text{ } 145 \text{ } 2\frac{1}{4}$$

$$\overset{\text{dolls.}}{\text{As } 5} + 4 + 3 + 2 + 1 = 15 \text{ the cost of 1 yard of each sort.}$$

$$\text{Then, as } \overset{\text{dolls.}}{15} : 1 :: \overset{\text{dolls. cts.}}{532,50} : 35\frac{1}{2}$$

16. Stated by the general rule it will be

$$\begin{array}{cccc} \text{mo.} & \text{mo.} & \text{dolls.} & \text{dolls.} \\ \text{As } 1 & : 12 & :: 127 & : 1524 \end{array}$$

$$17. \quad \begin{array}{cccc} \text{in.} & \text{in.} & \text{lb.} & \\ \text{As } 5 & : 36 & :: 5 & : \frac{36 \times 5}{5} = 360 \text{ pounds.} \end{array}$$

$$18. \quad \begin{array}{cccc} \text{lb.} & \text{lb.} & & \text{in.} \\ \text{As } 90 & : 5 & :: 18 & : 1 :: 36 & : 2 \text{ inches} \end{array}$$

19. $\frac{4}{7} = 8$ and $\frac{1}{2} = 5$ therefore it will be

$$\begin{array}{ccccccc} \text{yds.} & \text{dolls.} & \text{yds.} & \text{d.} & \text{c.} & \text{m.} \\ \text{As } 1 & : 2,7118 & :: 67,5 & : 183 & 04 & 6\frac{1}{2} \end{array}$$

$$20. \quad \begin{array}{cccc} \text{day} & \text{s.} & \text{d.} & \text{gr.} \\ \text{As } 1 & : 16 & 5 & 1\frac{1}{2} \end{array} :: 365$$

$$\begin{array}{r} 12 \\ \hline 197 \\ 4 \\ \hline 789 \\ 365 \\ \hline 3950 \\ 4735 \\ 2367 \\ \hline 4)288000* \end{array}$$

$$(12) \quad \begin{array}{r} 72000 \\ \hline 210) 60010 \end{array}$$

$$\begin{array}{r} 300L \end{array}$$

*Here omit multiplying by the third number, because you would immediately have to divide by the same number, to bring farthings.

$$21. \quad \begin{array}{cccc} \text{yds.} & \text{qrs.} & \text{ft.} & \text{sq. ft.} \\ 11 \times 3 = 33 \times 2\frac{1}{4} = 74,25 & \text{in a piece.} \end{array}$$

$$\text{And } 2 \begin{array}{cccc} \text{ft.} & \text{ft.} & \text{ft.} & \text{ft.} \\ (25 + 15) \times 10\frac{1}{2} = 80 \times 10\frac{1}{2} = 840. \end{array}$$

$$\text{But } \begin{array}{cccc} \text{sq. ft.} & 840 & \text{sq. ft.} & \text{sq. ft.} \\ 840 - \frac{840}{10} = 840 - 84 = 756 & \text{in the walls.} \end{array}$$

$$\begin{array}{cccc} \text{sq. ft.} & \text{piece} & \text{sq. ft.} \end{array}$$

$$\text{Then, as } 74,25 : 1 :: 756 : 10\frac{3}{4} \text{ pieces}$$

$$22. \quad \begin{array}{cccc} \text{ft.} & \text{ft.} & \text{in.} & \text{ft.} \\ \text{As } 50 & : 50 & 10\frac{1}{2} & :: 1287 & 4, \text{ that is} \end{array}$$

$$\begin{array}{cccc} \text{in.} & \text{in.} & \text{in.} & \text{in.} \\ \text{As } 600 & : 610\frac{1}{2} & :: 15448 & : 15718\frac{1}{2} = 1309 & 10\frac{1}{2} \end{array}$$

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23. $\begin{matrix} h.pt. & gal. & h.pt. & gal. \\ As & 16 (=1) & : & 15 :: 100 : 93\frac{1}{2} \end{matrix}$ gallons

DOUBLE RULE OF THREE.

Believing that it will be acceptable to some, I here insert two rules for stating the Double Rule of Three, in addition to that in the W. Calculator.

RULE FIRST. Place the three conditional terms in the following order: that which is the principal cause of gain, loss or action, possesses the first place; that which denotes space of time, or distance of place, the second; and that which is the gain, loss, or action the third; then place the other two terms, which move the question, under those of the same name, and if the blank space falls under the third, multiply the three last terms for a dividend, and the two first for a divisor: but if the blank fall under the first or second place, multiply the first, second, and last terms together for a dividend, and the other two for a divisor; and the quotient will be the answer.

RULE SECOND. Work by two statements of the Single Rule of Three.

Direct Proportion.

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Quest. 2. $\begin{matrix} \text{Horses} & 18 \\ \text{days} & 20 \end{matrix} \left. \vphantom{\begin{matrix} 18 \\ 20 \end{matrix}} \right\} 10 \text{ bushels. } \left\{ \begin{matrix} 60 \text{ horses} \\ 36 \text{ days} \end{matrix} \right.$

Then $\frac{10 \times 60 \times 36}{18 \times 20} = 10 \times 3 \times 2 = 60 \text{ bushels.}$

Or thus,

$\begin{matrix} \text{horses} & \text{days} & \text{bu.} \\ As & 18 : 20 :: 10 & \end{matrix}$ Then $\frac{10 \times 60 \times 36}{18 \times 20} = 60 \text{ bushels.}$
 $\begin{matrix} 60 : 36 \end{matrix}$

Or, by two statings,

$\begin{matrix} \text{horses} & \text{bu.} & \text{horses} \end{matrix}$

As $18 : 10 :: 60 : 33\frac{1}{2} \text{ bushels.}$

$\begin{matrix} \text{days} & \text{bu.} & \text{days} & \text{bushels} \end{matrix}$

And, as $20 : 33\frac{1}{2} :: 36 : 60 \text{ as before.}$

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Stated thus:

$$3. \quad \begin{array}{l} \text{Men } 7 \\ \text{days } 14 \end{array} \left. \vphantom{\begin{array}{l} \text{Men } 7 \\ \text{days } 14 \end{array}} \right\} 56 \text{ lb. } \left\{ \begin{array}{l} 21 \text{ men} \\ 3 \text{ days} \end{array} \right.$$

Or thus,
men days lbs.
 7—14—56
 21—3

$$\text{Then } \frac{56 \times 21 \times 3}{7 \times 14} = 4 \times 3 \times 3 = 36 \text{ pounds}$$

Or by two statings,

$$\text{As } \begin{array}{ccc} \text{men} & \text{men} & \text{lb.} \\ 7 & : 21 & :: 56 : 168, \text{ and} \end{array}$$

$$\text{As } \begin{array}{ccc} \text{days} & \text{days} & \text{lb.} \\ 14 & : 3 & :: 168 : 36 \text{ pounds.} \end{array}$$

Stated thus,

$$4. \quad \begin{array}{l} \text{Students } 8 \\ \text{months } 6 \end{array} \left. \vphantom{\begin{array}{l} \text{Students } 8 \\ \text{months } 6 \end{array}} \right\} \begin{array}{l} \text{dolls. } 384 \\ \end{array} \left\{ \begin{array}{l} 12 \text{ stud.} \\ 10 \text{ mo.} \end{array} \right.$$

Or thus,
stu. mo. dolls.
 8—6—384
 12—10

$$\text{Then, } \frac{384 \times 12 \times 10}{8 \times 6} = 48 \times 2 \times 10 = 960 \text{ dollars.}$$

Or by two statings,

$$\text{As } \begin{array}{ccc} \text{stu.} & \text{stu.} & \text{dolls.} \\ 8 & : 12 & :: 384 : 576, \text{ and} \end{array}$$

$$\text{As } \begin{array}{ccc} \text{mo.} & \text{mo.} & \text{dolls.} \\ 6 & : 10 & :: 576 : 960 \text{ dollars,} \end{array}$$

Stated thus,

$$5. \quad \begin{array}{l} \text{Cwt. } 20 \\ \text{miles } 50 \end{array} \left. \vphantom{\begin{array}{l} \text{Cwt. } 20 \\ \text{miles } 50 \end{array}} \right\} \begin{array}{l} \text{dolls. } 25 \\ \end{array} \left\{ \begin{array}{l} 40 \text{ cwt.} \\ 100 \text{ miles} \end{array} \right.$$

Or thus,
cwt. mi. dolls.
 20—50—25
 40—100

$$\text{Then, } \frac{25 \times 40 \times 100}{20 \times 50} = 25 \times 2 \times 2 = 100 \text{ dollars.}$$

Or by two statings,

$$\text{As } \begin{array}{ccc} \text{cwt.} & \text{cwt.} & \text{dolls.} \\ 20 & : 40 & :: 25 : 50, \text{ and} \end{array}$$

$$\text{As } \begin{array}{ccc} \text{miles} & \text{miles} & \text{dolls.} \\ 50 & : 100 & :: 50 : 100 \text{ dollars.} \end{array}$$

Stated thus,

$$6. \quad \begin{array}{l} \text{Dolls. } 700 \\ \text{months } 6 \end{array} \left. \vphantom{\begin{array}{l} \text{Dolls. } 700 \\ \text{months } 6 \end{array}} \right\} \begin{array}{l} \text{dolls. } 14 \\ \end{array} \left\{ \begin{array}{l} 400 \text{ dolls.} \\ 60 \text{ mo.} \end{array} \right.$$

Or thus,
dolls. mo. dolls.
 700—6—14
 400—60

$$\text{Then, } \frac{14 \times 400 \times 60}{700 \times 6} = 2 \times 4 \times 10 = 80 \text{ dollars.}$$

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Or by two statings,

dolls. dolls. dolls. dolls. mo. mo. dolls.
As 700 : 400 :: 14 : 8 and, As 6 : 60 :: 8 : 80 d.

Statement,

7. Men 4 } rods { 8 men
 12 }
days 6 } { 24 days

Or thus,

men days rods
4—6—12
8—24

Then, $\frac{12 \times 8 \times 24}{4 \times 6} = 2 \times 8 \times 6 = 96$ rods.

Or by two statings,

men men rods rods da. days rods
As 4 : 8 :: 12 : 24 and, As 6 : 24 :: 24 : 96 rods.

Inverse Proportion.

Stated thus,

Quest. 2. Men 4 inverse } days { 16 men inverse
 3 }
Dolls. 24 } { 384 dollars.

Or thus,

men days dolls.
4—3—24
16— —384

Then, $\frac{3 \times 4 \times 384}{16 \times 24} = 3 \times 4 \times 1 = 12$ days

Or by two statings,

dolls. dolls. days days men men days days
As 24 : 384 :: 3 : 48 and, As 16 : 4 :: 48 : 12

3. Dolls. 24 } men { 96 dollars *men days dolls.*
 4 } 4—3—24
day 3 inverse } { inverse 16 days. 16—96

Then, $\frac{4 \times 96 \times 3}{24 \times 16} = \frac{4 \times 4 \times 3}{16} = 3$ men.

Or by two statings,

dolls. dolls. men men days days men men
As 24 : 96 :: 4 : 16 and, As 16 : 3 :: 16 : 3

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Stated thus,

$$4. \text{ Acr. } 84 \left. \begin{array}{l} \text{men} \\ \text{inv. days } 12 \end{array} \right\} \begin{array}{l} 7 \\ 5 \text{ days inverse} \end{array} \left\{ \begin{array}{l} 100 \text{ acres} \\ 5 \text{ days inverse} \end{array} \right.$$

Or thus,

$$\begin{array}{l} \text{men days acres} \\ 7-12-84 \\ 5-100 \end{array}$$

$$\text{Then, } \frac{7 \times 100 \times 12}{84 \times 5} = \frac{1 \times 20 \times 1}{1 \times 1} = 20 \text{ men}$$

Or by two statings,

$$\begin{array}{l} \text{acres} \quad \text{acres} \quad \text{men} \quad \text{men} \quad \text{days} \quad \text{days} \quad \text{men} \quad \text{men} \\ \text{As } 84 : 100 :: 7 : 8\frac{1}{2} \text{ and, } \text{As } 5 : 12 :: 8\frac{1}{2} : 20 \end{array}$$

Stated thus,

$$5. \text{ Men inv. } 7 \left. \begin{array}{l} \text{days} \\ \text{acres } 84 \end{array} \right\} \begin{array}{l} 12 \\ 100 \text{ acres} \end{array} \left\{ \begin{array}{l} 20 \text{ men inv.} \\ 100 \text{ acres} \end{array} \right.$$

Or thus,

$$\begin{array}{l} \text{men days acres} \\ 7-12-84 \\ 20-0-100 \end{array}$$

$$\text{Then, } \frac{12 \times 7 \times 100}{20 \times 84} = \frac{1 \times 1 \times 5}{1 \times 1} = 5 \text{ days}$$

Or by two statings,

$$\begin{array}{l} \text{acres} \quad \text{days} \quad \text{acres} \quad \text{days} \quad \text{men} \quad \text{men} \quad \text{days} \\ \text{As } 84 : 12 :: 100 : 14\frac{2}{3} \text{ and, } \text{As } 20 : 7 :: 14\frac{2}{3} : 5 \text{ days} \end{array}$$

Stated thus,

$$6. \text{ Inverse } 200 \text{ lb. } \left. \begin{array}{l} \text{miles} \\ 40 \text{ cts.} \end{array} \right\} \begin{array}{l} 20200 \text{ lb. inverse.} \\ 6060 \text{ cents.} \end{array}$$

$$\begin{array}{l} \text{lbs.} \quad \text{miles} \quad \text{cts.} \\ \text{Or thus, } 200-40-40 \\ 20200-0-6060 \end{array}$$

$$\text{Then, } \frac{40 \times 200 \times 6060}{2020 \text{ lb.} \times 40 \text{ c.}} = 60 \text{ miles.}$$

Or by two statings,

$$\begin{array}{l} \text{cts.} \quad \text{mi.} \quad \text{cts.} \quad \text{miles} \\ \text{As } 40 : 40 :: 6060 : 6060, \text{ and } \\ \text{lb.} \quad \text{lb.} \quad \text{miles} \\ \text{As } 20200 : 200 :: 6060 : 60 \text{ miles.} \end{array}$$

Stated thus,

Or thus,

$$7. \$200 \left. \begin{array}{l} \text{w. da.} \\ \text{inv. men } 5 \end{array} \right\} \begin{array}{l} 22 \quad 6 \\ 12 \text{ men inv.} \end{array} \left\{ \begin{array}{l} 300 \text{ dolls.} \\ 12 \text{ men inv.} \end{array} \right.$$

$$\begin{array}{l} \text{men w. d. dolls.} \\ 5-22 \quad 6-200 \\ 12-0-300 \end{array}$$

$$\text{Then, } \frac{(22 \text{ w. } 6 \text{ da.}) \times 300 \times 5}{200 \times 12} = 14 \text{ weeks } 2 \text{ days.}$$

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Or by two statings,

dolls. dolls. w. d. w. d.
 As 200 : 300 :: 22 6 : 34 2 and,
men men w. d. w. d.
 As 12 : 5 :: 34 2 : 14 2

Promiscuous Questions.

Quest. 1. Stated thus, Or thus,
 12 oxen } acres { 24 oxen *oxen days acres*
 8 days } 10 { 48 days 12—8—10
 . 24—48—0

Then, $\frac{10 \times 24 \times 48}{12 \times 8} = 120$ acres.

Or by two statings,

ex. ox. acres acres days days acres
 As 12 : 24 :: 10 : 20 and, As 8 : 48 :: 20 : 120 acres

wt. wt. wt.
 2. 8000—4500=3500 and 9 days—6 days=3 days
 4500 cwt. } horses { 3500 cwt.
 inverse 6 days } 18 { 3 days inverse

horses days cwt.
 Or thus, 18—6—4500
 0—3—3500

Then, $\frac{18 \times 3500 \times 6}{4500 \times 3} = 28$ horses.

Or by two statings,

cwt. cwt. hor. hor. days days hor. hor.
 As 4500 : 3500 :: 18 : 14 and, As 3 : 6 :: 14 : 28

cwt. hhd. cwt. cwt. bbl. cwt.
 3. 12×9=108, and 2,5×50=125.

Stated thus, *cwt. mi. dolls.*
 108 cwt. } dolls. { 125 cwt. Or thus, 108—60—100
 60 miles } 100 { 300 miles 125—300—0

Then, $\frac{100 \times 125 \times 300}{108 \times 60} = 578$ dolls. 70 $\frac{1}{4}$ cents

Or by two statings,

mil. mil. dolls. dolls.
 As 60 : 300 :: 100 : 500, and
cwt. cwt. dolls. dolls. cts.
 As 108 : 125 :: 500 : 578 70 $\frac{1}{4}$

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$$4. \quad \begin{array}{l} 3 \text{ yds.} \\ 5 \text{ qrs.} \end{array} \left. \begin{array}{l} \} \text{ lb.} \\ \} 1 \end{array} \right\} \begin{array}{l} 45 \text{ yds.} \\ 4 \text{ qrs.} \end{array} \quad \text{Or,} \quad \begin{array}{r} \text{yds. qr. lb.} \\ 3-3-1 \\ 45-4-0 \end{array}$$

$$\text{Then, } \frac{1 \times 45 \times 4}{3 \times 5} = 12 \text{ yards}$$

By two statings,

$$\text{As } \begin{array}{cccc} \text{yds.} & \text{yds.} & \text{lb.} & \text{lb.} \\ 3 & : & 45 & :: 1 : 15 \end{array} \text{ and, } \begin{array}{cccc} \text{qrs.} & \text{qrs.} & \text{lb.} & \text{lb.} \\ 5 & : & 4 & :: 15 : 12 \end{array}$$

$$5. \quad \begin{array}{l} 240 \text{ miles} \\ \text{inverse 12 hours} \end{array} \left. \begin{array}{l} \} \text{ days} \\ \} 12 \end{array} \right\} \begin{array}{l} 720 \text{ miles} \\ 16 \text{ hrs. inv.} \end{array} \quad \text{Or thus,} \quad \begin{array}{r} \text{mil. days hrs.} \\ 240-12-12 \\ 720-0-16 \end{array}$$

$$\text{Then, } \frac{12 \times 720 \times 12}{240 \times 16} = \frac{12 \times 3 \times 12}{16} = 27 \text{ days.}$$

By two statings,

$$\text{As } \begin{array}{cccc} \text{miles} & \text{miles} & \text{days} & \text{days} \\ 240 & : & 720 & :: 12 : 36 \end{array} \text{ and, } \begin{array}{ccc} \text{hrs.} & \text{hrs.} & \text{days} \\ 16 & : & 12 & :: 36 : 27 \end{array} \text{ days}$$

$$6. \quad \begin{array}{l} 16,5 \text{ feet} \\ 1,5 \text{ feet} \\ 1 \text{ foot} \end{array} \left. \begin{array}{l} \} \text{ doll.} \\ \} 1 \\ \} 25 \end{array} \right\} \begin{array}{l} 50 \text{ feet} \\ 26 \text{ feet} \\ 4,5 \text{ feet} \end{array}$$

$$\text{Then, } \frac{1,25 \times 50 \times 26 \times 4,5}{16,5 \times 1,5 \times 1} = 177 \frac{27}{11} \text{ dolls. cts.}$$

$$7. \quad \begin{array}{l} 8 \text{ feet} \\ 4 \text{ feet} \\ 4 \text{ feet} \end{array} \left. \begin{array}{l} \} \\ \} 1 \text{ cord} \\ \} \end{array} \right\} \begin{array}{l} 200 \text{ feet long} \\ 10 \text{ feet high} \\ 36 \text{ feet broad} \end{array}$$

$$\text{Then, } \frac{1 \times 200 \times 10 \times 36}{8 \times 4 \times 4} = 562 \frac{1}{2} \text{ cords}$$

$$8. \quad \begin{array}{l} 10 \text{ yards} \\ 6 \text{ qrs.} \end{array} \left. \begin{array}{l} \} \text{ lb.} \\ \} 3 \end{array} \right\} \begin{array}{l} 100 \text{ yards} \\ 3 \text{ qrs.} \end{array}$$

$$\text{Then, } \frac{3 \times 100 \times 3}{10 \times 6} = 15 \text{ pound.}$$

Page 68.

$$9. \quad \begin{array}{l} \text{Inv. 24 men} \\ 200 \text{ ft. long} \\ 8 \text{ ft. high} \\ 6 \text{ ft. thick} \end{array} \left. \begin{array}{l} \} \\ \} \text{ days} \\ \} 80 \end{array} \right\} \begin{array}{l} 6 \text{ men inverse} \\ 20 \text{ feet long} \\ 6 \text{ feet high} \\ 4 \text{ feet thick} \end{array}$$

$$\text{Then, } \frac{80 \times 24 \times 20 \times 6 \times 4}{6 \times 200 \times 8 \times 6} = 16 \text{ days.}$$

Page 68.

10. 9 persons } *dolls.* { 14 (=9+5) persons
 5 months } 450 { 8 months

$$\text{Then } \frac{450 \times 14 \times 8}{9 \times 5} = 120 \text{ dollars}$$

11. 8 persons } *dolls.* { 12 (=8+4) persons
 1 month } 11½ { 6 months
 10 dollars } { 11 dollars

$$\text{Then } \frac{11\frac{1}{2} \times 12 \times 6 \times 11}{8 \times 10} = 111 \text{ } 37\frac{1}{2} \text{ } \text{\textit{dolls. cts.}}$$

12. 22,5 feet long } *days* { 45 feet long
 17,3 feet wide } { 34,6 feet wide
 10,25 ft. deep } 2,5 { 12,3 feet deep
 Inverse 6 men } { 9 men inverse
 Inverse 12,3 hours } { 8,2 days inverse

$$\text{Then } \frac{2,5 \times 45 \times 34,6 \times 12,3 \times 6 \times 12,3}{22,5 \times 17,3 \times 10,25 \times 9 \times 8,2} \text{ by cancelling*}$$

$$= \frac{2,5 \times 2 \times 2 \times 12,3}{10,25} = \frac{123}{10,25} = 12 \text{ days.}$$

PRACTICE.

Case 1. Page 69.

$$\begin{array}{r} \text{\textit{d. cts.}} \\ 2. \quad 1,75 \\ \quad 250 \text{ yards.} \\ \hline 8750 \\ 350 \\ \hline 8437,50 \end{array}$$

$$\begin{array}{r|l} \text{\textit{cts.}} & 250 \\ \text{Or, } 50 & 125 \\ 25 & 62,50 \\ \hline & 8437,50 \end{array}$$

* *Cancelling.* That is, when the divisor and dividend are the continued product of a number of factors, you can divide both by the same divisor; and the operation will be greatly abridged.

Thus, in the above example, I observe that 22,5 goes into 45 twice, without a remainder; that 17,3 is contained twice, in 34,6; and that 9×8,2 goes once into 6×12,3. Now, by dividing the numerator and denominator by these divisors, we obtain $\frac{2,5 \times 2 \times 2 \times 12,3}{10,25}$ as above

Page 69.

3. 201 yds.

4,20

4020

804

8844,20

Or, 201 yds.

4

804

20 cts. is $\frac{1}{5} = 40,2$

8844,20

4. 2210 yards
× 1,10 cents

82431,00

Or, $\begin{array}{c|c} \text{cts.} & \\ \hline 10 & \frac{1}{10} \end{array} \left| \begin{array}{c} 2210 \text{ yards} \\ 221 \end{array} \right.$

2431 dollars

5. 2,415

× 421 yards

2415

4830

9660

1016,715

Or, $\begin{array}{c} 421 \\ 2 \end{array}$ $\begin{array}{c|c|c} \text{cts.} & & \\ \hline 20 & \frac{1}{5} & 842 \\ 20 & \frac{1}{5} & 84,2 \\ 10 \text{ ms.} & \frac{1}{20} & 4,21 \\ 5 & \frac{1}{2} & 2,105 \end{array}$

Or, 1016 dolls. 71 cts. 5 ms.

1016,715

6. 625

25

3125

1250

8156,25

Or thus,

 $\begin{array}{c} \text{cts.} \\ 25 \text{ is } \frac{1}{4} \end{array} \quad 625$

8156,25

7. 8275
4,4 ms.

8275

33100

36410,0

Or, $\begin{array}{c} 8275 \\ 2 \end{array}$ $\begin{array}{c|c} \text{cts.} & \\ \hline 4 \text{ is } \frac{1}{25} & 331 \\ 4 \text{ ms. } \frac{1}{10} & 331 \end{array}$

364,10

Or, 364 dolls. 10 cts.

8. 8275

5

41375 mills.

Or, $\begin{array}{c} 8275 \\ 5 \end{array}$ $\begin{array}{c} 5 \text{ mills is } \frac{1}{200} \\ \text{Or, } 41 \text{ dolls. } 37 \text{ cts. } 5 \text{ ms.} \end{array}$

FRACTION.

Case 2. Page 69.

$$\begin{array}{r} \text{cwt.} \quad \text{qr.} \quad \text{lb.} \quad \text{lb.} \\ 2. \quad 4 \quad 1 \quad 14=490 \end{array}$$

$$\frac{1}{4}=122,5 \quad \text{Or, 122 dolls. 50 cts.}$$

$$\begin{array}{r} \text{cwt.} \quad \text{qr.} \quad \text{lb.} \quad \text{lb.} \\ 3. \quad 12 \quad 2 \quad 13=1413 \\ \times 2 \end{array}$$

$$3) 2826$$

$$\$ 942$$

$$\begin{array}{r} \text{cwt.} \quad \text{qr.} \quad \text{lb.} \quad \text{lb.} \\ 4. \quad 14 \quad 2 \quad 7=1631 \\ \times 7 \end{array}$$

$$\begin{array}{r} \text{lb.} \\ 5 \times 8=40 \end{array}) 11417$$

$$\$ 285,425$$

Application.

Page 70.

cwt. lb. hhds.

Quest. 1. $12,5 \times 112 \times 6 \times \frac{1}{4} = 3150$ dollars.

$$\begin{array}{r} 2. \quad 60 \text{ ton} \\ \times 3 \end{array}$$

$$5) 180$$

$$\begin{array}{r} \text{ton Eag.} \quad 36 \\ 60 \times 2 = \quad 120 \end{array}$$

$$156 \text{ Eagles}$$

Or, 1560 dolls.

$$\begin{array}{r} 3. \quad 12,650 \text{ feet} \\ \times 10 \end{array}$$

$$126,500$$

$$\frac{4}{3} \text{ is } \frac{1}{3} = 6,325$$

$$\frac{2}{3} \text{ is } \frac{1}{3} = 3,1625$$

$$\frac{1}{3} \text{ is } \frac{1}{3} = 1,58125$$

$$137,56875$$

Or, 137 dolls. 56 cts. $8\frac{1}{2}$ ms.

Case 3.

$$\begin{array}{r} \text{dolls.} \quad \text{cts.} \\ 2. \quad 10 \quad 94 \\ \text{Mult. by} \quad 17 \text{ cwt.} \end{array}$$

$$7658$$

$$1094$$

$$\begin{array}{r} 2 \text{ qr. is one half} \quad 547 \\ 1 \text{ is one half} \quad 2735 \\ 14 \text{ lb. is one half} \quad 13675 \\ 4 \text{ is one seventh} \quad 3907 \\ 1 \text{ is one fourth} \quad 976 \end{array}$$

$$\$ 196,0408$$

Or, 196 d. 4 cts.

$$\begin{array}{r} \text{dolls.} \quad \text{cts.} \\ 3. \quad 13 \quad 41 \\ \text{Mult. by} \quad 5 \text{ cwt.} \end{array}$$

$$67,05$$

$$1 \text{ qr. is } \frac{1}{4} = 3,352\frac{1}{2}$$

$$70,402\frac{1}{2}$$

70 dolls. 40 cts. $2\frac{1}{2}$ ms.

$$\begin{array}{r} \text{dolls. cts. ms.} \\ 4. \quad 15 \quad 00 \quad 5 \\ \times \quad \quad \quad 7 \\ \hline \end{array}$$

$$\begin{array}{r} 105,035 \\ 16 \text{ lb. is } \frac{1}{7} = 2,14357+ \\ 2 \text{ lb. is } \frac{1}{8} = ,26794+ \\ 1 \text{ lb. is } \frac{1}{2} = ,13397+ \\ \hline \end{array}$$

$$\hline 107,580:8+$$

107 dolls. 58 cts. &c.

Case 4. Page 71.

$$\begin{array}{r} \text{s. d.} \qquad \qquad \qquad \text{s. d.} \qquad \qquad \text{Or, 473 yards} \\ 2. \quad 6 \text{ 8 is } \frac{1}{3}) 473 \text{ yds. at } 6 \text{ 8} \qquad \qquad 88\frac{2}{3} \text{ cts.} \\ \hline \pounds 157 \text{ 13 } 4 \qquad \qquad \qquad 3784 \\ \qquad \qquad \qquad \qquad \qquad \qquad 3784 \end{array}$$

$$\begin{array}{r} \text{s. d.} \qquad \qquad \qquad \text{s. d.} \\ 3. \quad 3 \text{ 4 is } \frac{1}{6}) 397 \text{ yds. at } 3 \text{ 4} \qquad \qquad 420\frac{4}{9} \\ \hline \pounds 66 \text{ 3 } 4 \qquad \qquad \qquad \pounds 420,44\frac{4}{9} \end{array}$$

Or, 397 yards
,44 $\frac{4}{9}$ cts. = 3s. 4d.

$$\begin{array}{r} 1588 \\ 1588 \\ \frac{4}{9} = 176\frac{4}{9} \\ \hline \pounds 176,44\frac{4}{9} \end{array}$$

Or, 159,25
22 $\frac{2}{3}$ cts. = 1s. 8d.

$$\begin{array}{r} 4. \quad 159\frac{1}{4} \text{ lb. at } 1\text{s. } 8\text{d.} \\ \hline 1\text{s. } 8\text{d. is } \frac{1}{12}) 159 \text{ 5 value at } 1\text{L.} \qquad \qquad 31850 \\ \hline \pounds 13 \text{ 5 } 5 \qquad \qquad \qquad \frac{2}{9} = 3538\frac{2}{9} \\ \hline \pounds 35,3888\frac{2}{9} \end{array}$$

Or, $\pounds 35 \text{ } 38\frac{2}{9}$

Page 71.

<p>5. 10s. is $\frac{1}{2}$ 658 at 12s.</p> <hr style="width: 10%; margin-left: 150px;"/> <p>2 is $\frac{1}{3}$ 329</p> <p style="padding-left: 100px;">65 16</p> <hr style="width: 10%; margin-left: 150px;"/> <p style="padding-left: 50px;">£394 16</p>	<p>Or, 658lb.</p> <p style="padding-left: 100px;">160cts. = 12s.</p> <hr style="width: 10%; margin-left: 150px;"/> <p style="padding-left: 100px;">39480</p> <p style="padding-left: 100px;">658</p> <hr style="width: 10%; margin-left: 150px;"/> <p style="padding-left: 50px;">\$1052,80</p>
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<p>6. 10s. is $\frac{1}{2}$ 745 at 16s.</p> <hr style="width: 10%; margin-left: 150px;"/> <p>5s. is $\frac{1}{2}$ 372 10</p> <p>1s. is $\frac{1}{3}$ 186 5</p> <p style="padding-left: 100px;">37 5</p> <hr style="width: 10%; margin-left: 150px;"/> <p style="padding-left: 50px;">£596 0</p>	<p>Or, 745 yards</p> <p style="padding-left: 100px;">213$\frac{1}{2}$c. = 16s.</p> <hr style="width: 10%; margin-left: 150px;"/> <p style="padding-left: 100px;">2235</p> <p style="padding-left: 100px;">745</p> <hr style="width: 10%; margin-left: 150px;"/> <p style="padding-left: 100px;">1490</p> <p style="padding-left: 50px;">$\frac{1}{2}$ = 248$\frac{1}{2}$</p> <hr style="width: 10%; margin-left: 150px;"/> <p style="padding-left: 50px;">\$1589,33$\frac{1}{2}$</p>
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<p>7. 10s. is $\frac{1}{2}$ 969 at 19s. 11d.</p> <hr style="width: 10%; margin-left: 150px;"/> <p>5 ' $\frac{1}{4}$ 484 10</p> <p>4 ' $\frac{1}{5}$ 242 5</p> <p>8d. ' $\frac{1}{6}$ 193 16</p> <p>2 ' $\frac{1}{4}$ 32 6</p> <p>1 ' $\frac{1}{2}$ 8 1 6</p> <p style="padding-left: 100px;">4 0 9</p> <hr style="width: 10%; margin-left: 150px;"/> <p style="padding-left: 50px;">£964 19 3</p>	<p>Or,</p> <p style="padding-left: 100px;">969</p> <p style="padding-left: 100px;">265$\frac{1}{2}$cts. = 19s. 11d.</p> <hr style="width: 10%; margin-left: 150px;"/> <p style="padding-left: 100px;">4845</p> <p style="padding-left: 100px;">5814</p> <p style="padding-left: 100px;">1938</p> <p style="padding-left: 50px;">$\frac{1}{6}$ = 538$\frac{1}{2}$</p> <hr style="width: 10%; margin-left: 150px;"/> <p style="padding-left: 50px;">\$2573,23$\frac{1}{2}$</p>
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<p>8. 5s. $\frac{1}{4}$ 3715 at 9s. 4$\frac{1}{2}$d.</p> <hr style="width: 10%; margin-left: 150px;"/> <p>4 $\frac{1}{8}$ 928 15</p> <p>4d. $\frac{1}{12}$ 743 0</p> <p style="padding-left: 100px;">61 18 4</p> <p style="padding-left: 100px;">7 14 9$\frac{1}{2}$</p> <hr style="width: 10%; margin-left: 150px;"/> <p style="padding-left: 50px;">£1741 8 1$\frac{1}{2}$</p>	<p>Or, 3715</p> <p style="padding-left: 100px;">125c. = 9s. 4$\frac{1}{2}$d.</p> <hr style="width: 10%; margin-left: 150px;"/> <p style="padding-left: 100px;">18575</p> <p style="padding-left: 100px;">7430</p> <hr style="width: 10%; margin-left: 150px;"/> <p style="padding-left: 100px;">3715</p> <hr style="width: 10%; margin-left: 150px;"/> <p style="padding-left: 50px;">\$4643,75</p>
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Page 71.

9.		4567 at 19s. 11½d.	Or, 4567
10s.	½	—	266½c.=19s. 11½d.
5	¼	2283 10	
4	¼	1141 15	27402
8d.	¼	913 8	27402
2	¼	152 4 8	9134
1	¼	38 1 2	½ = 507½
½	¼	19 0 7	
		9 10 3½	812153,29½
		£4557 9 8½	

Case 2. Page 72.

£.	s.	d.		£.	s.	d.
2.	89	6	8×1	3.	8	11 5
		6				9
	536	0 0			77	2 9
		6				8
ewt.	3216	0 0			617	2 0
10 is ½	89	6 8	2 qr. is ½		4	5 8½
4 ' ½	44	13 4	1 ' ½		2	2 10½
2qr. ' ½	17	17 4	16 lb ' ½		1	4 5½+
14lb. ' ½	2	4 8	8 ' ½		0	12 2½+
	0	11 2	2 ' ½		0	3 0½+
			1 ' ½		0	1 6½
	£3870	13 2			£625	11 10
	£.	s.	d.			A. R. P.
4.	3	17	6	5.	476	3 28
		12			£	3 7s. 11d.
	46	10	0			
		12				
	558	0 0		5s. is ¼	1428	
2qr. is ½	1	18 9	2s. 6d. ' ½	119		
14lb. ' ½	0	9 8½	5d. ' ½	59	10	
7 ' ½	0	4 10	2r. is ½	9	18 4	
	£560	13 3½	1 ' ½	1	13 11½	
			20p. ' ½	0	16 11½	
			8 ' ½	8	5½+	
				3	4½	
					£1619	11 1½

Page 72.

d. c.
6. 10,55
640 acres

42200
6330

2r. is $\frac{1}{2}$ 5275
20p. $\frac{1}{4}$ 1318 $\frac{1}{4}$

86758,593 $\frac{1}{4}$

Or, 6758d. 59c. 3 $\frac{1}{4}$ m.

d. c.
7. 18,50
229 acres

16650
570
570

2r. is $\frac{1}{2}$ 925
1. ' $\frac{1}{4}$ 4625
10p ' $\frac{1}{4}$ 1156 $\frac{1}{4}$
8 ' $\frac{1}{4}$ 925

84252,456 $\frac{1}{4}$

Or, 4252d. 45c. 6 $\frac{1}{4}$ m

d. cts.
8. 6,34
12

lb. 7608
7 is $\frac{1}{16}$ 396 $\frac{1}{4}$

876,476 $\frac{1}{4}$

Or, 76d. 47 c. 6 $\frac{1}{4}$ m.

dolls.
9. 14
17 cwt.

238

2qr. is $\frac{1}{2}$ 7
1 ' ' $\frac{1}{4}$ 35
14lb. ' $\frac{1}{4}$ 175
7 ' ' $\frac{1}{4}$ 875
3 $\frac{1}{2}$ ' ' $\frac{1}{4}$ 437 $\frac{1}{2}$

8251,562 $\frac{1}{2}$

Or, 251d. 56c. 2 $\frac{1}{2}$ m.

d. c.
10. 125,50
16

200800

2r. is $\frac{1}{2}$ 6275
1 ' ' $\frac{1}{4}$ 31375
20per. ' $\frac{1}{4}$ 15687 $\frac{1}{2}$
5 ' ' $\frac{1}{4}$ 3921 $\frac{1}{2}$

82121,734 $\frac{1}{2}$

Or, 2121d. 73c 4m. +

TARE AND TRET.

Page 72.

	£.	s.	d.	
11.	3	17	6	
			5	
	99	7	6	
			5	
	96	17	6	value of 25 cwt.
2qr. is $\frac{1}{2}$	1	18	9	of 2 qrs.
1 ' ' $\frac{1}{2}$	0	19	4 $\frac{1}{2}$	of 1 qr.
14lb. ' $\frac{1}{2}$		9	8 $\frac{1}{4}$	14 lb.
	£100	5	3 $\frac{1}{2}$	

TARE AND TRET.

Page 73.

	cwt.	qr.	lb.	lb.
No. 1.	2	1	25	tare 21
' 2.	2	2	0	' 21
' 3.	2	0	21	' 21
Gross	7	0	18	tare 63 lb. = 2 qr. 7 lb.
Tare		2	7	
Neat cwt.	6	2	11	

	d.	c.	cwt.	qr.	lb.	lb.
	12,50		3.	16	1	3=1823 gross
	6					132 tare
2qrs. is $\frac{1}{2}$	75,00					1691 neat
3lb. ' $\frac{1}{4}$	6,25					Mult. ,45 cts.
2 ' ' $\frac{1}{2}$	892 $\frac{6}{7}$					8455
1 ' ' $\frac{1}{4}$	228 $\frac{3}{4}$					6764
	111 $\frac{1}{2}$					
	£82,477 $\frac{1}{2}$					£760,95

Page 74.

	<i>cwt.</i>	<i>qr.</i>	<i>lb.</i>	<i>lb.</i>	<i>d. cts.</i>
4. No. 1.	11	1	17	tare 112	16,80
' 2.	12	2	0	' 74	22
<hr/>					<hr/>
Gross	23	3	17	tare 186	33,60
186lb.=	1	2	18		336
<hr/>					<hr/>
	22	0	27	neat	16lb. is $\frac{1}{7}$ 2,40
					8 ' $\frac{1}{2}$ 1,20
					2 ' $\frac{1}{4}$ 30
					1 ' $\frac{1}{2}$ 15
<i>bbl. cts.</i>				<i>d. cts.</i>	
18×450	=	81,00			
Ton. $1\frac{1}{2}$ ×120 d.=	180,00				\$373,65 cost
					\$261,00 gave
					<hr/>
					\$112,65 due

	<i>cwt.</i>	<i>qr.</i>	<i>lb.</i>	<i>dolls.</i>
5. 4	2	26		9
		12		50 cwt.
<hr/>				<hr/>
	56	3	4 gross	450
<hr/>				<hr/>
8lb. is $\frac{1}{14}$	4	0	6+	2qr. is $\frac{1}{4}$ 4,50
4 ' $\frac{1}{2}$	2	0	3+	14 ' $\frac{1}{4}$ 1,12 $\frac{1}{2}$
				7 ' $\frac{1}{2}$ 56 $\frac{1}{4}$
				2 ' $\frac{1}{7}$ 16+
	6	0	9 tare	<hr/>
<hr/>				<hr/>
Cwt. 50	2	23	neat	\$456,34 $\frac{1}{2}$

	<i>cwt.</i>	<i>lb.</i>		<i>cwt.</i>	<i>qr.</i>	<i>lb.</i>	
6. 6=	672	gross		7. 120	3=	13524	gross
	100	tare				177	tare
<hr/>				<hr/>			
	572					13347	
$\frac{1}{10}$ =	22	tret		$\frac{1}{10}$ =	513,346	tret	
<hr/>				<hr/>			
lb. 550	neat				12833,654		
<hr/>				<hr/>			
						,73	cents
lbs. cts. lb.	8250	cts.			38500962		
As 550 : 8250 :: 1 :	$\frac{8250}{550}$	=15			89835578		
<hr/>				<hr/>			
					9368,56742		

Or, 9368 dolls. 56 cts. 7 ms.

Page 74.

<div> <div> <div>8.</div> <div>6</div> <div>2</div> <div>12</div> </div> <div> <div>9</div> </div> </div>				<div> <div>16 dollars</div> <div>50 cwt.</div> </div>			
<hr/> <div> <div>59</div> <div>1</div> <div>24</div> <div>gross</div> </div>				<hr/> <div> <div>800</div> </div>			
<hr/> <div> <div>16lb. is $\frac{1}{4}$</div> <div>8</div> <div>1</div> <div>27</div> </div>				<div> <div>1qr. is $\frac{1}{4}$</div> <div>4</div> </div>			
<div> <div>1</div> <div>'</div> <div>$\frac{1}{16}$</div> <div>2</div> <div>3</div> </div>				<div> <div>14lb. ' $\frac{1}{2}$</div> <div>2</div> </div>			
<hr/> <div> <div>9</div> <div>0</div> <div>2</div> <div>tare</div> </div>				<div> <div>7 ' $\frac{1}{2}$</div> <div>1</div> </div>			
<hr/> <div> <div>Cwt. 50</div> <div>1</div> <div>22</div> <div>neat</div> </div>				<div> <div>1 ' $\frac{1}{7}$</div> <div>0,14$\frac{3}{4}$</div> </div>			
				<hr/> <div> <div>8807,14$\frac{3}{4}$</div> </div>			

$\text{lb. cwt. qr. lbs bags lb.}$
 9. $325 (= 2 \text{ } 3 \text{ } 17) \times 27 = 8775 \text{ gross}$
 $8775 \text{ lb.} \times \frac{1}{112} = 1018 \text{ tare}$

 7757
 $7757 \div 26 = 298 \text{ tret}$

 $7459 \text{ lb.} = 66 \text{ cwt. } 2 \text{ qr. } 11 \text{ lbs.}$

lbs. ct. dolls. cts.
And $7459 \times 32 = 2386,88$

SIMPLE INTEREST.

Case 1. Page 75.

dolls. dolls. yr. cts. :

4. $200 \times 6 \times 2 = 2400 = 24$ dollars

Page 76.

	dolls.	dolls.	yr.	cts.	dolls.	cts.
5.	1260	$\times 7$	$\times 4$	$= 35280$	$= 352,80$	

	dolls.	dolls.	yrs.	cts.	dolls.	cts.
6.	560	×	8	×	3	= 13440 = 134.40

Now $\begin{array}{ccc} d. & cts. & \\ 134,40 & + 560 & = 694,40 \end{array}$

7. $\begin{array}{ccccccc} & d. & & d. & yrs. & cts. & \\ & & & & & & d. & cts. \\ 7. & 4520 & \times 5 & \times 6 & = & 135600 & = & 1356,00 \end{array}$

And $\overset{d.}{1356,00} + \overset{cts.}{4520} = \overset{d.}{5876}$ dollars

Page 76.

$$\begin{array}{l} \text{dolls. d. yrs. cts.} \qquad \qquad \qquad \text{d. d. d.} \\ 8. \quad 400 \times 6\frac{1}{2} \times 2 = 5200 = 52 \text{ dolls.} \quad \text{And } 52 + 400 = 452 \end{array}$$

$$\begin{array}{l} \text{dolls. dolls. yrs. cents} \qquad \text{d. cts. ms.} \\ 9. \quad 4925 \times 7\frac{1}{2} \times 9 = 332437\frac{1}{2} = 3324 \text{ } 37 \text{ } 5 \end{array}$$

$$\begin{array}{l} \text{dolls. dolls. cts. dolls. cts.} \\ 10. \quad 2500 \times 7\frac{3}{4} = 19375 = 193 \text{ } 75 \end{array}$$

$$\begin{array}{l} \text{d. c. d. d. cts.} \\ \text{And } 193 \text{ } 75 + 2500 = 2693 \text{ } 75 \end{array}$$

Case 2. Page 77.

$$\begin{array}{r} \begin{array}{l} \text{dolls. c. ms.} \\ 4. \quad 1260 \text{ } 50 \text{ } 5 \\ \qquad \qquad 7\frac{1}{2} \\ \hline 8823535 \\ 6302525 \\ \hline \end{array} \qquad \begin{array}{l} \text{d. cts. ms.} \\ \text{Now } 283 \text{ } 61 \text{ } 3+ \\ \hline 1260 \text{ } 50 \text{ } 5 \\ \hline \end{array} \\ \hline \end{array}$$

cents 9453,7875 interest for 1 year
3

28361,3625

Or, 283 dolls. 61 cts. 3+ms. interest for three years

$$\begin{array}{l} \text{dolls. cts.} \qquad \text{dollars cts. d. yrs. d. cts. ms.} \\ 5. \quad 630 \text{ } 50 \qquad 6. \quad 3462 \text{ } 84 \times 3\frac{1}{4} \times 4 = 450 \text{ } 1692 \text{ int.} \\ \qquad \qquad \qquad 8 \qquad \qquad 1274 \text{ } 646 \times 7\frac{1}{2} \times 3 = 286 \text{ } 79535 \text{ int.} \\ \hline \end{array}$$

$$\begin{array}{l} 50 \text{ } 4400 \text{ int. for 1 year} \qquad \qquad \qquad 163 \text{ } 37385 \text{ diff.} \\ \hline 5 \end{array}$$

232 20 int. for 5 years

650 50 principal

dolls. cts. ms.

Or, 163 37 3,85

\$882 70 amount

$$\begin{array}{l} \text{dolls. cts.} \\ 7. \quad 3) 3422 \text{ } 25 \\ \hline \end{array}$$

$$\begin{array}{l} \text{dolls. cts. ms.} \\ 1140 \text{ } 75 \times \frac{6}{100} = 68 \text{ } 44 \text{ } 5 \text{ int. for 1 year} \\ 68 \text{ } 44 \text{ } 5 \text{ interest for one year} \\ \hline \end{array}$$

1209 19 5 first payment.

Case 4. Page 80.

$$5. \begin{array}{ccccccc} \text{dolls.} & \text{days} & (\text{constant div.}) & \text{d.} & \text{cts.} & & \\ (12000 \times 40) & \div & 5214 & = & 92 & 06 & \text{nearly} \end{array}$$

$$6. \begin{array}{ccccccc} \text{dolls.} & \text{days} & (\text{c. d.}) & \text{d.} & \text{cts.} & \text{ms.} & \\ (8400 \times 20) & \div & 7300 & = & 23 & 01 & 3 \end{array}$$

$$7. \begin{array}{ccccccc} \text{d.} & \text{cts.} & \text{days} & (\text{c. d.}) & & & \\ (517 \ 90 \times 84) & \div & 6083 & = & 7 \text{ dolls.} & 15 \text{ cts.} & 1 \text{ m.} \end{array}$$

$$8. \begin{array}{ccccccc} \text{d.} & \text{cts.} & \text{days} & (\text{c. d.}) & & & \\ (73 \ 41 \times 27) & \div & 60 & = & 33 & \text{cts} & \end{array}$$

$$9. \begin{array}{ccccccc} \text{dolls.} & \text{cts.} & \text{days} & (\text{c. d.}) & \text{d} & \text{c.} & \text{m.} \\ (225 \ 24 \times 40) & \div & 6083 & = & 1 & 48 & 1 \end{array}$$

$$10. \begin{array}{ccccccc} \text{dolls.} & \text{days} & (\text{c. d.}) & \text{d.} & \text{c.} & \text{m.} & \\ (1200 \times 80) & \div & 6083 & = & 15 & 78 & 1 \end{array}$$

$$11. \begin{array}{ccccccc} \text{dollars} & \text{cts.} & \text{days} & (\text{c. d.}) & \text{d.} & \text{cts.} & \text{m.} \\ (2962 \ 19 \times 254) & \div & 6083 & = & 123 & 68 & 8 \end{array}$$

$$12. \begin{array}{ccccccc} \text{d.} & \text{cts.} & \text{days} & (\text{c. d.}) & \text{d.} & \text{c.} & \text{m.} \\ (1733 \ 97 \times 102) & \div & 6083 & = & 29 & 07 & 5 \end{array}$$

Case 5. Page 81.

$$2. \begin{array}{ccccccc} \text{yrs.} & \text{d.} & \text{d.} & \text{d.} & & & \\ (12 \times 6) & + & 100 & = & 172 & \text{Then,} & \end{array}$$

$$\text{As } 172 : 100 :: 2752 : \frac{2752 \times 100}{172} = 1600 \text{ dolls.}$$

$$3. \begin{array}{ccccccc} \text{yrs.} & \text{d.} & \text{d.} & \text{d.} & & & \\ (5 \times 6) & + & 100 & = & 130 & \text{Then,} & \end{array}$$

$$\text{As } 130 : 100 :: 728 : \frac{728 \times 100}{130} = 560 \text{ dolls.}$$

$$4. \begin{array}{ccccccc} \text{yrs.} & \text{d.} & \text{d.} & \text{d.} & & & \\ (4 \times 7\frac{1}{2}) & + & 100 & = & 130 & \text{Then,} & \end{array}$$

$$\text{As } 130 : 100 :: 1638 : \frac{1638 \times 100}{130} = 1260 \text{ dolls.}$$

$$5. \begin{array}{ccccccc} \text{yrs.} & \text{d.} & \text{cts.} & \text{d.} & \text{d.} & \text{cts.} & \\ (5 \times 5 \ 75) & + & 100 & = & 128 \ 75 & \text{Then,} & \end{array}$$

$$\text{As } 128 \ 75 : 100 :: 2000 : \frac{2000 \times 100}{128,75} = 1553 \ 39 \ 8\frac{1}{2} \text{ ms.}$$

Case 6. Page 82.

$$\begin{array}{rcl}
 \text{2.} & \begin{array}{l} \text{dolls.} \\ 858 \text{ amount} \\ 650 \text{ principal} \\ \hline \end{array} & \begin{array}{l} \text{As } 650 : 280 :: 100 : \frac{20800}{650} = 32 \\ \text{Then } 32 \text{ d.} \div 4 \text{ yrs.} = 8 \text{ per cent.} \end{array}
 \end{array}$$

\$208 interest

$$\begin{array}{rcl}
 \text{3.} & \begin{array}{l} \text{dolls.} \\ 2752 \text{ amount} \\ 1600 \text{ prin.} \\ \hline \end{array} & \begin{array}{l} \text{As } 1600 : 1152 :: 100 : \frac{115200}{1600} = 72 \\ \text{Then } 72 \text{ dolls.} \div 12 \text{ yrs.} = 6 \text{ dollars} \end{array}
 \end{array}$$

\$1152 interest.

$$\begin{array}{rcl}
 \text{4.} & \begin{array}{l} \text{dolls. cts.} \\ 860,80 \text{ amount} \\ 640,00 \text{ prin.} \\ \hline \end{array} & \begin{array}{l} \text{As } 640 : 220,80 :: 100 : \frac{22080}{640} = 34\frac{1}{2} \\ \text{Then } 34\frac{1}{2} \text{ d.} \div 6 \text{ yrs.} = 5\frac{3}{4} \text{ per cent.} \end{array}
 \end{array}$$

\$220,80 interest.

$$\begin{array}{rcl}
 \text{5.} & \begin{array}{l} \text{dolls.} \\ 20100 \text{ amount} \\ 12000 \text{ prin.} \\ \hline \end{array} & \begin{array}{l} \text{As } 12000 : 8100 :: 100 : \frac{810}{12} = 67\frac{1}{2} \\ \text{Then } 67\frac{1}{2} \text{ d.} \div 15 \text{ yrs.} = 4\frac{1}{2} \text{ per cent.} \end{array}
 \end{array}$$

\$ 8100 interest.

Case 7. Page 83.

$$\begin{array}{rcl}
 \text{2.} & \begin{array}{l} \text{dolls.} \\ 650 \\ 8 \\ \hline \end{array} & \begin{array}{l} \text{dolls.} \\ 910 \text{ amount} \\ 650 \text{ principal} \\ \hline \end{array}
 \end{array}$$

\$52,00 int. for 1 year \$260 whole interest

$$\text{Then, as } \begin{array}{l} \text{dolls.} \\ 52 \end{array} : \begin{array}{l} \text{year} \\ 1 \end{array} :: \begin{array}{l} \text{dolls.} \\ 260 \end{array} : \frac{260}{52} = 5 \text{ years}$$

$$\begin{array}{rcl}
 \text{3.} & \begin{array}{l} \text{dolls.} \\ 1600 \\ 6 \\ \hline \end{array} & \begin{array}{l} \text{dolls.} \\ 2080 \text{ amount} \\ 1600 \text{ principal} \\ \hline \end{array}
 \end{array}$$

\$96,00 int. for 1 year \$ 480 whole interest

$$\text{Then, as } \begin{array}{l} \text{dolls.} \\ 96 \end{array} : \begin{array}{l} \text{year} \\ 1 \end{array} :: \begin{array}{l} \text{dolls.} \\ 480 \end{array} : \frac{480}{96} = 5 \text{ years}$$

Case 8. Page 83.

2. 640£. 3s. 6d. = $2845\frac{2}{5}$ dollars $\$142,26\frac{1}{3}$ interest for 1 year426,78 $\frac{1}{3}$ interest for 3 years
2845,22 $\frac{2}{3}$ principal $\$3272,000\frac{5}{9}$ amount*

	£.	s.	d.	£.	s.	d.	
3.	1374	1	9	77	5	10	in'st. for 1 yr.
rate per cent.		5 $\frac{5}{8}$		38	12	11	for $\frac{1}{2}$ yr.
	6870	8	9	£115	18	9	int. for 1 $\frac{1}{2}$ yr.
$\frac{4}{8}$ is $\frac{1}{2}$	687	0	10 $\frac{1}{2}$				
$\frac{1}{8}$ is $\frac{1}{4}$	171	15	2 $\frac{1}{2}$				
	£77,29	4	10				
	20						
	3.5,84						
	12						
	d.10,18						

Case 9. Page 85.

2	1820, January.	Principal	1800 dollars
	<i>dolls.</i>		<i>days</i>
1821—April 1.	1800	Mult. by	455 equal 819000
	paid 700		
1822—Jan. 1.	1100	Mult.	275 equal 302500
	paid 400		
	700	Mult.	181 equal 102500
July 1, paid	500		
	200	Mult.	184 equal 36800
	214 16 6		
Amount due	\$414 16 6		6,0) 1285000
		Interest	\$ 214,166

* The answer given with the question is obtained by reckoning \$4,44 to be a pound sterling, instead of \$4,44 $\frac{1}{2}$.

COMPOUND INTEREST.

Page 87.

3. *tabular number* *dolls.* *d.* *cts.*
 $1,27628 \times 1500 = 1914 \ 42$
4. *tabular no.* *d.* *d.* *c.* *m.*
 $2,54035 \times 4500 = 11431 \ 57 \ 5$ amount
 subtract 4500 principal

 $\$6931 \ 57 \ 5$ interest
5. *tabular no.* *d.* *d.* *cts.*
 $3,20713 \times 650 = 2084 \ 63 \ 4,5$ mills
6. *yrs.* *yrs.*
 $21 - 4 = 17$ years, on interest. Then,
tabular no. *d.* *d.* *cts.*
 $2,69277 \times 8000 = 21542 \ 16$ amount
d. *cts.* *sons*
 But $21542 \ 16 \div 3 = 7180$ dollars 72 cents

INSURANCE.

Page 88.

2. *dolls.*
 1650
 $15\frac{1}{2}$ per cent.

 8250
 1650
 825

 $\$255,75$
3. *dolls.*
 4500
 25 per cent.

 22500
 90

 $\$1125,00$
5. 100 dollars—25 dollars=75 dollars. Then,
dolls. *dolls.* *dolls.* *dolls.*
 As $75 : 100 :: 4500 : \frac{450000}{75} = 6000$
6. 100 dolls.—9 dolls.=91 dolls. Then
dolls. *dolls.* *dolls.* *dolls.* *cts.*
 As $91 : 100 : 560 : \frac{56000}{91} = 615 \ 38\frac{1}{2}$

COMMISSION.

Page 88.

$$\begin{array}{r}
 \text{2.} \quad \text{dolls.} \\
 1260 \\
 \text{6 per cent.} \\
 \hline
 \$75,60
 \end{array}$$

$$\begin{array}{r}
 \text{3.} \quad \text{dolls.} \\
 2550 \\
 \text{4 per cent.} \\
 \hline
 \$102,00
 \end{array}$$

$$\begin{array}{r}
 \text{4.} \quad \text{dolls.} \\
 26342 \\
 \text{3 per cent.} \\
 \hline
 \$790,26
 \end{array}$$

$$\begin{array}{r}
 \text{5.} \quad \text{dolls.} \\
 6422 \\
 \text{3 per cent.} \\
 \hline
 4) 19266 \\
 \hline
 \$48,16\frac{1}{2}
 \end{array}$$

Page 89.

$$\begin{array}{r}
 \text{7.} \quad 100 \text{ dollars.} \\
 3
 \end{array}$$

$$\text{As } 103 : 100 :: 4120 \frac{\text{dolls.}}{103} = 4000 \text{ dolls.}$$

$$\text{Then, as } 8 : 1 :: 4000 : \frac{4000}{8} = 500 \text{ barrels}$$

BROKAGE.

$$\begin{array}{r}
 \text{2.} \quad \text{d. cts.} \\
 1625,50 \\
 \text{3}\frac{1}{2} \text{ per cent.} \\
 \hline
 4876,50 \\
 541,83\frac{1}{2} \\
 \hline
 5418,33\frac{1}{2}
 \end{array}$$

$$\begin{array}{r}
 \text{3.} \quad \text{dolls.} \\
 1868 \\
 \text{2}\frac{1}{2} \text{ per cent.} \\
 \hline
 3736 \\
 934 \\
 \hline
 846,70
 \end{array}$$

Or, 54 dolls. 18½ cts.

$$\begin{array}{r}
 \text{4.} \quad 560 \text{ dollars} \\
 \text{6 per cent.} \\
 \hline
 \$33,60 \text{ cents}
 \end{array}$$

BUYING AND SELLING STOCKS.

Page 90.

	<i>dolls.</i>	<i>dolls.</i>	<i>dolls.</i>
2.	1500	Or, 1500	3. 1686
	110 per cent.	$\frac{1}{10} = 150$	$\times 128$ per cent.
	<hr/>	<hr/>	<hr/>
	\$1650,00	\$1650	13488
			3372
			<hr/>
			1686
4.	<i>dolls.</i>		
	25000		
	108 per cent.		
	<hr/>		
	\$27000		\$2158,08
5.	<i>d.</i>	6. <i>d.</i>	7. <i>d.</i>
	1260	9254	1518
	90 per cent.	84 per cent.	$83\frac{3}{4}$ per cent.
	<hr/>	<hr/>	<hr/>
	\$1124	\$7773,36	\$1271,92 $\frac{1}{2}$

REBATE OR DISCOUNT.

Page 91.

2.	As	<i>mo.</i>	<i>d.</i>	<i>mo.</i>	<i>d.</i>	12 : 8 :: 18 : 12 int. for the time	Then,
As	<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>		112 : 100 :: 2464 : 2200	Because $\frac{2464 \times 100}{112} = 2200$ <i>dolls.</i>
3.	As	<i>mo.</i>	<i>d.</i>	<i>mo.</i>	<i>d.</i>	12 : 5 $\frac{1}{2}$:: 8 : 3 $\frac{2}{3}$ interest for the time	
Then,	as	<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>cts.</i>	103 $\frac{2}{3}$: 100 :: 1857 50 : 1791 80 $\frac{20}{11}$ <i>cts.</i>	
For						$\frac{185750 \times 100 \times 3}{103\frac{2}{3} \times 3} = 1791 80\frac{20}{11}$ <i>dolls. cts.</i>	
4.						(7 × 2) + 100 = 114 dollars	
Then,	as	<i>dolls.</i>	<i>dolls.</i>	<i>dolls.</i>		114 : 14 :: 650 : $\frac{650 \times 14}{114} = 79 82\frac{2}{3}$ <i>dolls. cts.</i>	

Page 91.

5. As $\overset{\text{mo.}}{12} : \overset{\text{mo.}}{4\frac{1}{2}} :: \overset{\text{d.}}{8} : \overset{\text{d.}}{3} = \text{a rate for the time}$

Then, as $\overset{\text{dolls.}}{103} : \overset{\text{dolls.}}{100} :: \overset{\text{dolls.}}{5150} : \frac{5150 \times 100}{103} = 5000 \overset{\text{dolls.}}{\text{p. w.}}$

Again,

As $100 : 99 (=100-1) :: \overset{\text{dolls.}}{5000} : \overset{\text{dolls.}}{4950}$

Page 92. Note 1st.

3. As $\overset{\text{mo.}}{12} : \overset{\text{mo.}}{18} :: \overset{\text{dolls.}}{8} : \overset{\text{dolls.}}{12} \text{ rate for the time}$

Then, as $\overset{\text{dolls.}}{112} : \overset{\text{dolls.}}{12} :: \overset{\text{dolls.}}{7280} : \overset{\text{dolls.}}{780} \text{ the discount}$

Again, $\overset{\text{dolls.}}{7280} \times \overset{\text{mo.}}{9} = 65520 \overset{\text{cents}}{\text{interest at 6 per cent.}}$

$\frac{1}{3} = 21840 \overset{\text{cents}}{\text{interest at 2 ' ' '}}$

8873,60 interest at 8 per cent.

Subtract 8780,00 discount

Difference \$ 93,60

Note 2d.

2. $\overset{\text{dolls.}}{1650} \times \overset{\text{dolls.}}{3} = 4950 = 49 \text{ dollars } 50 \text{ cents.}$

3. $2464 \text{ dollars} \times 8 = 19712 \text{ cents discount}$

But $2464 \text{ dollars} - 19712 \text{ cents} = 2266 \text{ dollars } 88 \text{ cents}$

BANK DISCOUNT.

Page 93.

2. $\overset{\text{days}}{(30+4)} \times \overset{\text{dolls.}}{250} = 1 \text{ dollar } 41\frac{2}{3} \text{ cents}$
60

Or, $\frac{17 \times 250}{30} = 1 \text{ dollar } 41\frac{2}{3} \text{ cents}$

3. $\overset{\text{days}}{(90+4)} \times \overset{\text{dolls.}}{600} = 9 \text{ dollars } 40 \text{ cents}$
60

Or, $\frac{47 \text{ days} \times 600 \text{ dolls.}}{30} = 9 \text{ dollars } 40 \text{ cents}$

Page 93.

$$4. \frac{\begin{array}{c} \text{days} \\ (60+4) \times 1260 \end{array} \begin{array}{c} \text{dolls. cts.} \\ 40 \end{array}}{60} = 13 \text{ dollars } 44\frac{32}{75} \text{ cents.}$$

$$\text{Or, } \frac{32 \times 1260 \ 40}{30} = 13 \text{ dollars } 44\frac{32}{75} \text{ cents.}$$

$$5. \frac{\begin{array}{c} \text{days} \\ (60+4) \times 2649 \end{array} \begin{array}{c} \text{dolls. cts.} \\ 75 \end{array}}{60} = 28 \text{ dollars } 26 \text{ cents } 4 \text{ mills}$$

$$\text{Or, } \frac{32 \times 2649 \ 75}{30} = 28 \text{ dollars } 26 \text{ cents } 4 \text{ mills}$$

EQUATION OF PAYMENTS.

Page 94.

$$2. \begin{array}{l} \text{dolls. mo.} \\ 500 \times 2 = 1000 \\ 1000 \times 5 = 5000 \\ 1500 \times 8 = 12000 \end{array}$$

$$3. \begin{array}{l} \text{dolls. mo.} \\ 200 \times 5 = 1000 \\ 300 \times 8 = 2400 \\ 500 \times 10 = 5000 \end{array}$$

$$\begin{array}{r} 3000 \quad) \quad 18000 \quad (6 \text{ mo.} \\ \underline{18000} \end{array} \quad \begin{array}{r} 1000 \quad) \quad 8400 \quad (8 \ 12 \text{ mo. da.} \\ \underline{8400} \end{array}$$

$$4. \ 1400 \text{ dollars} - 1000 \text{ dollars} = 400 \text{ dollars}$$

$$\text{Then, as } \begin{array}{c} d \\ 400 \end{array} : \begin{array}{c} d \\ 1000 \end{array} :: \begin{array}{c} mo. \\ 1 \end{array} : 2\frac{1}{2} \text{ months}$$

SINGLE FELLOWSHIP.

Page 95.

$$2. \begin{array}{c} d \\ A \end{array} 7500 + \begin{array}{c} d \\ B \end{array} 6000 + \begin{array}{c} d \\ C \end{array} 4500 = 18000, \text{ Then,}$$

$$\text{As } \begin{array}{c} \text{dolls.} \\ 18000 \end{array} : \begin{array}{c} \text{dolls.} \\ 5400 \end{array} :: 10 : 3 :: \left\{ \begin{array}{l} \begin{array}{c} \text{dolls.} \\ 7500 \end{array} : \begin{array}{c} \text{dolls.} \\ 2250 \end{array} \text{ A's gain} \\ \begin{array}{c} \text{dolls.} \\ 6000 \end{array} : \begin{array}{c} \text{dolls.} \\ 1800 \end{array} \text{ B's} \\ \begin{array}{c} \text{dolls.} \\ 4500 \end{array} : \begin{array}{c} \text{dolls.} \\ 1350 \end{array} \text{ C's} \end{array} \right\}$$

$$3. \begin{array}{c} d \\ A \end{array} 1291 \begin{array}{c} cts. \\ 23 \end{array} + \begin{array}{c} d \\ B \end{array} 500 \begin{array}{c} cts. \\ 37 \end{array} + \begin{array}{c} d \\ C \end{array} 709 \begin{array}{c} cts. \\ 40 \end{array} + 228 = 2729$$

$$\text{Now, as } \begin{array}{c} d \\ 2729 \end{array} : \begin{array}{c} d \\ 2046 \end{array} :: \begin{array}{c} cts. \\ 75 \end{array} : 100 : \begin{array}{c} d \\ 75 \end{array}$$

$$\text{Then, as } 100 : 75 :: \left\{ \begin{array}{l} \begin{array}{c} d \\ 1291 \end{array} \begin{array}{c} cts. \\ 23 \end{array} : \begin{array}{c} d \\ 968 \end{array} \begin{array}{c} cts. \\ 42\frac{1}{4} \end{array} \\ \begin{array}{c} d \\ 500 \end{array} \begin{array}{c} cts. \\ 37 \end{array} : \begin{array}{c} d \\ 375 \end{array} \begin{array}{c} cts. \\ 27\frac{1}{4} \end{array} \\ \begin{array}{c} d \\ 709 \end{array} \begin{array}{c} cts. \\ 40 \end{array} : \begin{array}{c} d \\ 532 \end{array} \begin{array}{c} cts. \\ 05 \end{array} \\ \begin{array}{c} d \\ 228 \end{array} \begin{array}{c} cts. \\ 00 \end{array} : \begin{array}{c} d \\ 171 \end{array} \end{array} \right\}$$

Page 95.

$$\begin{array}{c}
 \text{dolls. } A. R. P. \\
 4. \text{ As } 600 : 585 \text{ } 2 \text{ } 34 :: \left\{ \begin{array}{l} \text{dolls. } A. R. P. \\ 180 : 175 \text{ } 2 \text{ } 34\frac{1}{2} \\ 195 : 190 \text{ } 1 \text{ } 17\frac{1}{2} \\ 225 : 219 \text{ } 2 \text{ } 22\frac{1}{2} \end{array} \right\}
 \end{array}$$

Page 96.

$$\begin{array}{c}
 \text{bbl. } \text{bbl.} \\
 5. \text{ As } 2160 : 900 \text{ } \therefore 12 \text{ } 5 :: \left\{ \begin{array}{l} \text{barrels.} \\ 960 : 400 \\ 720 : 500 \\ 480 : 200 \end{array} \right\}
 \end{array}$$

$$\begin{array}{c}
 \text{dolls. } d. \quad d. \\
 6. \text{ A } 1260 + \text{B } 840 = 2100, \quad \text{And } 825 - 275 = 550
 \end{array}$$

$$\begin{array}{c}
 d. \quad d. \\
 \text{Now, as } 2100 : 550 :: \left\{ \begin{array}{l} d. \quad d. \\ 1260 : 330 \text{ A's gain} \\ 840 : 220 \text{ B's } \end{array} \right\}
 \end{array}$$

$$\begin{array}{c}
 \text{B's gain. B's stock.} \\
 \text{And, as } 220 : 840 \text{ } \therefore 11 : 42 :: 275 : 1050 \text{ C's stock}
 \end{array}$$

$$\begin{array}{c}
 \text{dolls. } \text{dolls. } \text{dolls.} \\
 7. (800 \times 2) + 40 = 1640. \text{ whole gain, And}
 \end{array}$$

$$\begin{array}{c}
 d. \quad d. \quad d. \quad d. \\
 \text{A's } 140 + \text{B's } 260 + \text{C's } 300 = 700
 \end{array}$$

Then, 800 dollars—700 dollars=100 dollars D's stock.

$$\begin{array}{c}
 \text{dolls. } \text{dolls} \\
 \text{Now, as } 800 : 1640 \text{ } \therefore 20 : 41 :: \left\{ \begin{array}{l} \text{dolls. } \text{dolls} \\ 140 : 287 \text{ A's gain} \\ 260 : 533 \text{ B's } \\ 300 : 615 \text{ C's } \\ 100 : 205 \text{ D's } \end{array} \right\}
 \end{array}$$

8.

$$\begin{array}{c}
 \text{cattle } \text{dolls.} \\
 \text{As } 500 : 96 \text{ } \therefore 25 : 8 :: \left\{ \begin{array}{l} d. \text{ cts.} \\ 80 : 25 \text{ } 60 \text{ A pays} \\ 100 : 32 \text{ } 00 \text{ B } \\ 120 : 38 \text{ } 40 \text{ C } \end{array} \right\}
 \end{array}$$

9. First $2+3+5=10$ dollars, Then

$$\begin{array}{c}
 \text{dolls. } \text{dolls.} \\
 \text{As } 10 : 5000 \text{ } \therefore 1 : 500 :: \left\{ \begin{array}{l} \text{dolls.} \\ 2 : 1000 \text{ A gets} \\ 3 : 1500 \text{ B } \\ 5 : 2500 \text{ C } \end{array} \right\}
 \end{array}$$

7

Page 96.

10. 20 dollars + 85 dollars = 105 dollars whole stock

d. d. d. d.

Now, as 105 : 63 :: 20 : 12 A's gain

d. d. d. d.

And 63 — (21 + 12) = 63 — 33 = 30 C's gain

d. d.

Then, as *dolls. dolls.* 12 : 20 :: $\left\{ \begin{array}{l} 21 : 35 \text{ B put in} \\ 30 : 50 \text{ C put in} \end{array} \right\}$

COMPOUND FELLOWSHIP.

Page 97.

d. mo.
2. 600 × 8 = 4800
200

800 × 8 = 6400

A 11200

1000 × 12 = 12000
800

1800 × 4 = 7200

C 19200

d. mo.
1200 × 10 = 12000
600

600 × 6 = 3600

B 15600

11200 A

15600 B

19200 C

46000

dolls. Now, as 46000 : 2300 :: $\left\{ \begin{array}{l} 11200 : 560 \text{ dolls. A's share} \\ 15600 : 780 \text{ dolls. B's} \\ 19200 : 960 \text{ dolls. C's} \end{array} \right.$
That is 20 : 1

mo. mo. dolls. dolls.
3. As 9 : 12 :: 600 : 800

Page 98.

mo. mo. d.
4. As 8 : 12 :: 1800 : 2700 dollars.

mi. mi. mi. mi.
5. A 600 + B 600 + C 500 + D 100 = 1800 miles

miles dolls. As 1600 : 160 :: $\left\{ \begin{array}{l} 600 : 60 \text{ dolls. A pays} \\ 600 : 60 \text{ ' B} \\ 500 : 50 \text{ ' C} \\ 100 : 10 \text{ ' D} \end{array} \right.$

Page 98.

$$\begin{array}{rcl} 6. & 5 \text{ oxen} \times 4\frac{1}{2} \text{ months} & = 22\frac{1}{2} \\ & 8 \quad \times 5 & = 40 \\ & 9 \quad \times 6\frac{1}{2} & = 58\frac{1}{2} \\ & \hline & & \end{array}$$

Sum 121

$$\begin{array}{rcl} & d. & cts. \\ \text{Now, as } 121 : 145 & 20 :: \left\{ \begin{array}{l} 22\frac{1}{2} : 27 \text{ A pays} \\ 40 : 48 \text{ B} \\ 58\frac{1}{2} : 70 \text{ 20 C} \end{array} \right. & \end{array}$$

$$\begin{array}{rcl} 7. & 4000 \text{ dollars} \times 12 \text{ months} & = 48000 \\ & 3000 \quad \times 15 & = 45000 \\ & 5000 \quad \times 8 & = 40000 \\ & \hline & & 133000 \end{array}$$

$$\begin{array}{rcl} & d. & \\ \text{As } 133000 : 665 :: \left\{ \begin{array}{l} 48000 : 240 \text{ dolls. A's part} \\ 45000 : 225 \quad \text{B's} \\ \text{That is } 200 : 1 \quad 40000 : 200 \quad \text{C's} \end{array} \right. & \end{array}$$

$$\begin{array}{rcl} 8. & 580 \text{ dollars} \times 6\frac{1}{2} \text{ months} & = 3770 \\ & 580 \quad \times 9\frac{1}{2} & = 5510 \\ & 870 \quad \times 8\frac{3}{4} & = 7540 \\ & \hline & & 16820 \end{array}$$

$$\begin{array}{rcl} & d. & cts. \\ \text{As } 16820 : 263 & 90 :: \left\{ \begin{array}{l} 3770 : 59d. 15c. \text{ A lost} \\ 5510 : 86 \quad 45 \text{ B} \\ 7540 : 118 \quad 30 \text{ C} \end{array} \right. & \end{array}$$

PROFIT AND LOSS.

Page 99.

$$\begin{array}{rcl} 1. & 150 \text{ cents, sold for} \\ & 120 \text{ cents, cost} \\ & \hline \end{array}$$

30 cents, gain on 120 cents

$$\begin{array}{rcl} & cts. & cts. & d. & d. \\ \text{Then, as } 120 : 30 :: 100 : 25 & \text{per cent} & \end{array}$$

$$\begin{array}{rcl} & yd. & cts. & yds. & d. & cts. \\ 3. & \text{As } 1 : 66 :: 42 : 27 & 72 \text{ sold for} \\ & \text{Subtract } 21 & 00 \text{ cost} \\ & \hline \end{array}$$

Rem. \$ 6 72 gain

Page 99.

4. 32 galls. \times 6 barrels = 192 gallons, bought
 Subtract 12 gallons leaked out

Rem. 180 gallons

And 96 dollars + 12 dollars = 108 dollars sold for

Then, as $\begin{matrix} \text{galls.} & \text{d.} & \text{gal.} & \text{cts.} \end{matrix}$ 192 : 96 :: 1 : 50 cost per gallon

And, as $\begin{matrix} \text{g.} & \text{d.} & \text{g.} & \text{cts.} \end{matrix}$ 180 : 108 :: 1 : 60 sold for per gallon

5. 20 cents—17 cents = 3 cents, loss on each knife
 $\begin{matrix} \text{knife} & \text{cts.} & \text{knives} & \text{doz.} & \text{d.} & \text{cts.} \end{matrix}$
 As 1 : 3 :: 1440 (=120) : 43 20

Page 100.

6. 149 dollars
 51 "

7. 100 dollars
 18 "

$\begin{matrix} \text{yds.} & \text{—} & \text{yd.} & \text{d.} \end{matrix}$
 As 100 : \$200 :: 1 : 2

$\begin{matrix} \text{d.} & \text{—} & \text{cts.} & \text{d.} & \text{c.} & \text{ms.} \end{matrix}$
 As 100 : \$82 :: 125 : 1 02 5

8. As 100 : 120 :: 90 : 1 08 must sell for
 108 cts.—90 cts. = 18 cts. gain per hat

$\begin{matrix} \text{hat} & \text{cts} & \text{hats} & \text{doz.} & \text{d.} & \text{cts.} \end{matrix}$
 Now, as 1 : 18 :: 240 (=20) : 43 20

9. 115 gallons \times 110 cents = 126 50 cost
 Add 5 00

\$131 50 must sell for

But, as 1 doll. : 1 gall. :: 131 dolls. 50 cts. : 131½ galls.
 the number of gallons that must be sold. Consequently
 131½ gallons—115 gallons = 16½ gallons of water.

10. $\begin{matrix} \text{lb.} & \text{cwt.} & \text{cts.} \end{matrix}$ 134 40 cost
 448 (=4) \times 25 = 112 00 sold for

\$ 22 40 whole loss

Then, as $\begin{matrix} \text{lb.} & \text{dolls.} & \text{cts.} & \text{lb.} \end{matrix}$ 448 : 22 40 :: 1 : 5 cents per lb.

Page 104.

$$3. \text{ As } \overset{d.}{90} (\overset{s.}{=7} \overset{d.}{6}) : \overset{d.}{56} (\overset{s.}{=4} \overset{d.}{8}) :: \overset{L.}{1500} : \overset{L.}{933} \overset{s.}{6} \overset{d.}{8}$$

$$\text{Or, } \frac{\pounds 1500 \times 3\frac{1}{2}}{5} = 933 \text{ } 6 \text{ } 8 \text{ Answer as before}$$

$$4. \text{ As } \overset{s.}{6} : \overset{s.}{8} :: \overset{L.}{180} : \overset{L.}{240} \quad \text{Or, } \frac{\pounds 180}{\frac{2}{3}} = 60$$

 $\pounds 240$ as before

$$5. \text{ As } \overset{d.}{56} (\overset{s.}{=4} \overset{d.}{8}) : \overset{d.}{72} (\overset{s.}{=6}) :: \overset{L.}{280} : \overset{L.}{360}$$

$$\text{Or, } \frac{\pounds 280}{\frac{2}{3}} = 80 \text{ add}$$

 $\pounds 360$ as before

$$6. \text{ As } \overset{d.}{72} (\overset{s.}{=6}) : \overset{d.}{56} (\overset{s.}{=4} \overset{d.}{8}) :: \overset{L.}{304} : \overset{L.}{236} \overset{s.}{8} \overset{d.}{10\frac{2}{3}}$$

$$\text{Or, } \frac{304}{\frac{1}{3}} = 33 \text{ } 15 \text{ } 6\frac{2}{3}$$

$$\begin{array}{r} 270 \text{ } 4 \text{ } 5\frac{1}{3} \\ 33 \text{ } 15 \text{ } 6\frac{2}{3} \\ \hline \end{array}$$

$$\pounds 236 \text{ } 8 \text{ } 10\frac{2}{3}$$

Case 2. Page 105.

$$4. \overset{L.}{468} \overset{s.}{19} \overset{d.}{6} = 9379,5 \text{ Then, } \overset{s.}{9379,5} \div \overset{s.}{6} = 1563 \text{ } 25$$

$$5. \overset{L.}{750} \overset{s.}{10} = 180120 \text{ Then, } 180120 \div \overset{d.}{90} = 2001 \text{ } 33\frac{1}{2}$$

Case 3. Page 108.

$$5. \overset{L.}{540} \overset{s.}{15} = 540,75 \text{ Then, } \pounds 540,75 \times 84,10 = \$2217 \text{ } 07\frac{1}{2}$$

$$6. \frac{2217 \text{ dolls. } 07 \text{ cts. } 5 \text{ ms.}}{4 \text{ dolls. } 10 \text{ cts.}} = \overset{L.}{540,75} = \overset{L.}{540} \overset{s.}{15}$$

Page 108.

$$\begin{array}{r}
 \text{£.} \quad \text{d.} \quad \text{cts.} \quad \text{d.} \quad \text{cts.} \\
 7. \quad 320 \times 4 \quad 44 = 1420 \quad 80 \quad \text{at par} \\
 \quad 12\frac{1}{2} \text{ is } \frac{1}{8} = 177 \quad 60 \quad \text{add} \\
 \hline
 \quad \quad \quad \text{£}1598 \quad 40
 \end{array}$$

Page 109.

$$8. \quad \text{£}3259 \div \text{£}4 \quad 10 = \text{£}794,878, \quad \text{Then,}$$

$$\begin{array}{ccc}
 \text{£.} & \text{£.} & \text{£.} \\
 \text{As } 108 : 100 :: 794,878 : 735,9999, \text{ or } 736 \text{ nearly}
 \end{array}$$

Otherwise,

$$\begin{array}{r}
 \text{£}3259 \times 100 \\
 \hline
 \text{£}4,10 \times 108
 \end{array}
 = 735\frac{1105}{1107} = 735 \quad 19 \quad 11\frac{1}{2} \quad \frac{2}{3}, \text{ or } 736 \text{ nearly.}$$

ALLIGATION.

Case 1.

$$\begin{array}{r}
 2. \quad 20 \text{ lbs. at } 10 \text{ cents} = 200 \\
 \quad 30 \text{ " at } 15 \text{ " } = 450 \\
 \quad 40 \text{ " at } 25 \text{ " } = 1000 \\
 \hline
 \quad \quad \quad \text{cts. } 1650
 \end{array}$$

$$\begin{array}{ccc}
 \text{lb.} & \text{cts.} & \text{lb.} \quad \text{cts.} \\
 \text{Now, as } 90 : 1650 :: 1 : 18\frac{1}{2}
 \end{array}$$

$$\begin{array}{r}
 3. \quad 10 \text{ bushels at } 150 \text{ cents} = 1500 \\
 \quad 20 \text{ " at } 160 \text{ " } = 3200 \\
 \quad 30 \text{ " at } 170 \text{ " } = 5100 \\
 \hline
 \quad \quad \quad 9800
 \end{array}$$

$$\begin{array}{ccc}
 \text{bu.} & \text{d.} & \text{bu.} \quad \text{cts.} \\
 \text{Now, as } 60 : 98 :: 1 : 163\frac{1}{2}
 \end{array}$$

Page 110.

$$\begin{array}{r}
 4. \quad 4 \text{ ounces at } 75 \text{ cents} = 300 \\
 \quad 8 \text{ " at } 60 \text{ " } = 480 \\
 \hline
 \quad \quad \quad 780
 \end{array}$$

$$\begin{array}{ccc}
 \text{oz.} & \text{cts.} & \text{oz.} \quad \text{cts.} \\
 \text{Now, as } 12 : 780 :: 1 : 65
 \end{array}$$

Case 2. Page 110.

$$2. \quad 4 \left\{ \begin{array}{l} 3 \\ 5 \\ 6 \end{array} \right\} \quad \begin{array}{l} 1+2=3 \text{ gallons at 3 dollars} \\ 1 = 1 \quad \text{at 5} \\ 1 = 1 \quad \text{at 6} \end{array}$$

Or, Or,

$$3. \quad 25 \left\{ \begin{array}{l} 40 \\ 30 \\ 20 \end{array} \right\} \quad \begin{array}{l} 5 \mid 1 \mid 6 \text{ bushels of rye} \\ 5 \mid 1 \mid 6 \quad \text{of corn} \\ 15+5=20 \mid 4 \mid 24 \quad \text{of oats} \end{array}$$

$$4. \quad \begin{array}{l} 1st. \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 20 \text{ at } 120 \\ 10 \quad 110 \\ 10 \quad 90 \\ 20 \quad 80 \end{array} \\ 100 \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 20 \text{ at } 120 \\ 10 \quad 110 \\ 10 \quad 90 \\ 20 \quad 80 \end{array} \end{array} \quad \begin{array}{l} 2d. \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 10+20=30 \text{ at } 120 \\ =20 \quad 110 \\ =20 \quad 90 \\ 20+10=30 \quad 80 \end{array} \end{array}$$

$$3d. \quad \begin{array}{l} \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 10 \text{ at } 120 \\ 20 \quad 110 \\ 20 \quad 90 \\ 10 \quad 80 \end{array} \\ 100 \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 10 \text{ at } 120 \\ 20 \quad 110 \\ 20 \quad 90 \\ 10 \quad 80 \end{array} \end{array} \quad \begin{array}{l} 4th. \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} =10 \text{ at } 120 \\ 10+20=30 \quad 110 \\ 20+10=30 \quad 90 \\ =10 \quad 80 \end{array} \end{array}$$

$$5th. \quad \begin{array}{l} \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 10+20=30 \text{ at } 120 \text{ cents} \\ =10 \quad 110 \\ 20+10=30 \quad 90 \\ =20 \quad 80 \end{array} \\ 100 \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 10+20=30 \text{ at } 120 \text{ cents} \\ =10 \quad 110 \\ 20+10=30 \quad 90 \\ =20 \quad 80 \end{array} \end{array}$$

$$6th. \quad \begin{array}{l} \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} =20 \text{ at } 120 \text{ cents} \\ 10+20=30 \quad 110 \\ =10 \quad 90 \\ 20+10=30 \quad 80 \end{array} \\ 100 \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} =20 \text{ at } 120 \text{ cents} \\ 10+20=30 \quad 110 \\ =10 \quad 90 \\ 20+10=30 \quad 80 \end{array} \end{array}$$

$$7th. \quad \begin{array}{l} \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 10+20=30 \text{ at } 120 \text{ cents} \\ 10+20=30 \quad 110 \\ 20+10=30 \quad 90 \\ 20+10=30 \quad 80 \end{array} \\ 100 \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 10+20=30 \text{ at } 120 \text{ cents} \\ 10+20=30 \quad 110 \\ 20+10=30 \quad 90 \\ 20+10=30 \quad 80 \end{array} \end{array}$$

Case 3. Page 112.

$$2. \quad 22 \left\{ \begin{array}{l} 48 \\ 36 \\ 30 \\ 18 \end{array} \right\} \quad \begin{array}{l} = 4 \\ = 4 \\ = 4 \\ 26+14+8=48 \text{ given,} \end{array}$$

Now, as 48 : 24bu :: 4 : 2 bushels of each sort.

Page 114.

$$4. \quad 4800 \overline{) 10800} (2 \quad \text{Then, } 1200 \overline{) \frac{4800}{10800}} (= \frac{2}{9})$$

$$\text{com. measure } 1200 \overline{) 4800} (4 \quad \text{Or, } \frac{4800}{10800} = \frac{4}{9} \text{ as before}$$

$$5. \quad 91 \overline{) 117} (1$$

$$91$$

$$\hline$$

$$26 \overline{) 91} (3$$

$$78$$

$$\text{com. measure } 13 \overline{) 26} (2$$

$$26$$

$$\text{Then, } 13 \overline{) \frac{91}{117}} (= \frac{1}{3})$$

$$6. \quad 9876 \overline{) 88884} (9 \quad \text{Therefore, } 9876 \overline{) \frac{88884}{111111}} (= \frac{1}{11})$$

$$88884$$

Case 2. Page 115.

$$2. \quad \frac{12 \times 17 + 15}{17} = \frac{219}{17} \text{ fraction required.}$$

$$3. \quad \frac{183 \times 21 + 5}{21} = \frac{3848}{21} \text{ fraction required}$$

$$4. \quad \frac{514 \times 16 + 5}{16} = \frac{8229}{16} \text{ fraction required}$$

$$5. \quad \frac{68425 \times 4 + 3}{4} = \frac{273703}{4} \text{ fraction required.}$$

Case 3.

$$2. \quad 3848 \div 21 = 183 \frac{5}{21} \text{ equivalent mixed number}$$

$$3. \quad 2465 \div 7 = 352 \frac{1}{7} \text{ equivalent mixed number}$$

$$4. \quad 961 \div 17 = 56 \frac{9}{17} \text{ equivalent mixed number}$$

$$5. \quad 8229 \div 16 = 514 \frac{5}{16} \text{ equivalent mixed number}$$

Case 4. Page 116.

$$2. \quad 3 \times 5 \times 6 = 90 \text{ first numerator}$$

$$4 \times 4 \times 6 = 96 \text{ second numerator}$$

$$5 \times 4 \times 5 = 100 \text{ third numerator}$$

$$\text{And } 4 \times 5 \times 6 = 120 \text{ common denominator}$$

$$\text{Therefore, } \frac{90}{120}, \frac{96}{120} \text{ and } \frac{100}{120} \text{ are the fractions required}$$

Page 116.

8. $1 \times 5 \times 15 \times 9 = 675$ first numerator

$3 \times 3 \times 15 \times 9 = 1215$ second

$4 \times 3 \times 5 \times 9 = 540$ third

$5 \times 3 \times 5 \times 15 = 1125$ fourth

And $3 \times 5 \times 15 \times 9 = 2025$ common denominator

Therefore, $\frac{675}{2025}$, $\frac{1215}{2025}$, $\frac{540}{2025}$ and $\frac{1125}{2025}$ are the frac. required

Case 5.

2. $4) 3 \quad 8 \quad 12 \quad 20$

$3) 3 \quad 2 \quad 3 \quad 5$

$1 \quad 2 \quad 1 \quad 5$

Now, $4 \times 3 \times 2 \times 5 = 120$ common denominator

Then, 120 com. denominator

Divisors $\left\{ \begin{array}{l|l} 3 & 40 \times 2 = 80 \\ 8 & 15 \times 3 = 45 \\ 12 & 10 \times 4 = 40 \\ 20 & 6 \times 5 = 30 \end{array} \right\}$ New numerators

Hence, $\frac{80}{120}$, $\frac{45}{120}$, $\frac{40}{120}$ and $\frac{30}{120}$

Page 117.

3. $3) 3 \quad 5 \quad 15 \quad 9$

$5) 1 \quad 5 \quad 5 \quad 3$

$1 \quad 1 \quad 1 \quad 3$

Now, $3 \times 5 \times 3 = 45$ common denominator

Then, 45 com. denominator

Divisors $\left\{ \begin{array}{l|l} 3 & 15 \times 1 = 15 \\ 5 & 9 \times 3 = 27 \\ 15 & 3 \times 4 = 12 \\ 9 & 5 \times 5 = 25 \end{array} \right\}$ New numerators

Hence, $\frac{15}{45}$, $\frac{27}{45}$, $\frac{12}{45}$, and $\frac{25}{45}$

Case 6.

2. $7 \times 4 \times 9 = 252$ num.

$8 \times 6 \times 10 = 480$ denom.

Or, 3

$\frac{7 \times 4 \times 9}{8 \times 6 \times 10} = \frac{7 \times 3}{2 \times 2 \times 10} = \frac{21}{40}$

Hence, $\frac{21}{40}$

Page 117.

3. $5 \times 4 \times 3 = 60$ num.

$9 \times 8 \times 4 = 288$ denom.

Hence, $\frac{60}{288} = \frac{5}{24}$

Or, $\frac{5 \times \cancel{4} \times \cancel{3}}{\cancel{9} \times \cancel{8} \times 4} = \frac{5}{3 \times 2 \times 4} = \frac{5}{24}$

4. $5 \times 4 \times 11 = 220$ num.

$9 \times 7 \times 12 = 756$ denom.

Hence, $\frac{220}{756} = \frac{55}{189}$

Or, $\frac{5 \times \cancel{4} \times 11}{9 \times 7 \times \cancel{12}} = \frac{5 \times 11}{9 \times 7 \times 3} = \frac{55}{189}$

Case 7.

2. $\frac{4 \times 1 \times 1}{5 \times 20 \times 12} = \frac{4}{1200} = \frac{1}{300}$ fraction required

3. $\frac{\cancel{10} \times 1 \times 1}{13 \times 8 \times \cancel{63}} = \frac{1}{13 \times 8 \times 7} = \frac{1}{728}$

Page 118.

4. $\frac{\cancel{10} \times 1 \times 1}{11 \times \cancel{60} \times 24} = \frac{1}{11 \times 6 \times 24} = \frac{1}{1584}$

Case 8.

2. $\frac{1 \times 12 \times 20}{300 \times 1 \times 1} = \frac{240}{300} = \frac{4}{5}$ fraction required

3. $\frac{1 \times 63 \times 8}{728 \times 1 \times 1} = \frac{504}{728} = \frac{9}{13}$ fraction required

4. $\frac{1 \times 24 \times 60}{1584 \times 1 \times 1} = \frac{1440}{1584} = \frac{10}{11}$ fraction required

Case 9.

2. $\frac{12 \text{ ounces}}{3} = 1 \text{ pound}$

$$\begin{array}{r} 5 \overline{) 36} \\ \underline{} \end{array}$$

7 ounces 4 pennyweights

Page 119.

3. $\frac{8 \text{ furlongs}}{4} = 1 \text{ mile}$

4. $\frac{24 \text{ hours}}{3} = 1 \text{ day}$

$$\begin{array}{r} 5 \overline{) 32} \\ \underline{} \end{array}$$

$$\begin{array}{r} 10 \overline{) 72} \\ \underline{} \end{array}$$

6 furlongs 16 perches

7 hours 12 min.

8

Page 119.

$$5. \quad 100 \text{ cents} = 1 \text{ dollar}$$

4

$$5 \overline{) 400}$$

80 cents

Case 10.

$$3. \quad 31 \text{ galls. } 2 \text{ qts.}$$

4

126 quarts

$$63 \text{ galls.} = 1 \text{ hhd.}$$

4

252 quarts

Wherefore, $\frac{126}{252} = \frac{1}{2}$ is the fraction required

$$4. \quad \begin{array}{r} \text{cwt. qr. lb.} \\ 6 \ 2 \ 18\frac{2}{3} \\ 4 \end{array}$$

26

28

216

53

746

3

$$\begin{array}{r} \text{cwt.} \\ 20 = 1 \text{ ton} \\ 4 \end{array}$$

80

28

2240

3

6720 thirds of a pound

2240 thirds of a pound

Wherefore, $\frac{2240}{6720} = \frac{1}{3}$ is the fraction required

Case 11. Page 120.

$$2. \quad 20 \overline{) 17,00} (,85$$

ADDITION OF VULGAR FRACTIONS.

Case 1.

$$2. \quad \frac{4+8+13+16+19}{25} = \frac{60}{25} = 2\frac{1}{5}$$

$$3. \quad \frac{15+25+45+55}{60} = \frac{140}{60} = 2\frac{1}{3}$$

Case 2. Page 121.

Given denominators	40 com. denominator
2. $\begin{array}{r} 2) 2 \ 4 \ 5 \ 8 \\ \hline 2) 1 \ 2 \ 5 \ 4 \\ \hline 1 \ 1 \ 5 \ 2 \end{array}$	And $\begin{array}{r l} 2 & 20 \text{ first numerator} \\ 4 & 10 \text{ second} \\ 5 & 8 \text{ third} \\ 8 & 5 \text{ fourth} \end{array}$

Then, $2 \times 2 \times 5 \times 2 = 40$ common denominator

Wherefore, $\frac{20+10+8+5}{40} = \frac{43}{40} = 1\frac{3}{40}$

Given denominators	840 com. denominator
3. $\begin{array}{r} 5) 5 \ 6 \ 7 \ 8 \ 15 \\ \hline 3) 1 \ 6 \ 7 \ 8 \ 3 \\ \hline 2) 1 \ 2 \ 7 \ 8 \ 1 \\ \hline 1 \ 1 \ 7 \ 4 \ 1 \end{array}$	Then, $\begin{array}{r l} 5 & 168 \times 4 = 672 \\ 6 & 140 \times 5 = 700 \\ 7 & 120 \times 6 = 720 \\ 8 & 105 \times 3 = 315 \\ 15 & 56 \times 8 = 448 \end{array}$

Now, $5 \times 3 \times 2 \times 7 \times 4 = 840$ com. denom 2855 sum

Wherefore, $\frac{2855}{840} = 3\frac{67}{168}$

Case 3. Page 122.

3. $\frac{4}{5}$ of $\frac{1}{3} = \frac{4}{15}$

Then, $\frac{3}{5} + \frac{4}{15} + \frac{3}{20} = \frac{36+16+9}{60} = \frac{61}{60} = 1\frac{1}{60}$

Wherefore, $1 + 9 + 1\frac{1}{60} = 11\frac{1}{60}$

4. $\frac{3}{4}$ of $\frac{1}{2} = \frac{3}{8}$

Then, $\frac{9}{10} + \frac{7}{8} + \frac{1}{2} + \frac{1}{2} = \frac{108+105+40+60}{120} = \frac{313}{120} = 2\frac{73}{120}$

Lastly, $1 + 6 + 7 + 2\frac{73}{120} = 16\frac{73}{120}$

Case 4.

2.
$$\begin{array}{r} \text{ft. in.} \\ \frac{1}{2} \text{ of a yard} = 1 \ 6 \\ \frac{2}{3} \text{ of a foot} = 0 \ 8 \\ \hline \end{array}$$

Sum 2 ft. 2 in.

3.
$$\begin{array}{r} \text{h. m.} \\ \frac{1}{2} \text{ of a day} = 8 \ 0 \\ \frac{1}{4} \text{ of an hour} = 0 \ 30 \\ \hline \end{array}$$

Sum 8 h. 30 mi.

Page 122.

	<i>d. h. m</i>		<i>yds. ft. in.</i>
4.	$\frac{1}{2}$ of a week = 2 8 0	5.	$\frac{7}{8}$ of a mile = 1540 0 0
	$\frac{1}{4}$ of a day = 0 6 0		$\frac{2}{3}$ of a yard = 0 2 0
	$\frac{1}{2}$ of an hour = 0 0 30		$\frac{3}{4}$ of a foot = 0 0 9
Sum 2 d. 14 hrs. 30 mi.		1540 y. 2 ft. 9 in.	

SUBTRACTION OF VULGAR FRACTIONS.

Page 123.

$$4. \quad \frac{11}{12} - \frac{3}{4} = \frac{11}{12} - \frac{9}{12} = \frac{11-9}{12} = \frac{2}{12} = \frac{1}{6}$$

$$5. \quad \frac{5}{6} - \frac{4}{5} = \frac{25}{30} - \frac{24}{30} = \frac{25-24}{30} = \frac{1}{30}$$

$$6. \quad \frac{209}{216} - \frac{7}{144} = \frac{418}{432} - \frac{21}{432} = \frac{418-21}{432} = \frac{397}{432}$$

$$7. \quad \frac{15}{16} - \frac{11}{12} = \frac{45}{48} - \frac{44}{48} = \frac{45-44}{48} = \frac{1}{48}$$

$$8. \quad 12\frac{5}{12} - 6\frac{1}{2} = 12\frac{5}{12} - 6\frac{6}{12} = 5\frac{11}{12}$$

$$9. \quad 13\frac{1}{9} - 8\frac{14}{27} = 13\frac{3}{27} - 8\frac{14}{27} = 4\frac{16}{27}$$

$$10. \quad 10\frac{3}{10} - 1\frac{7}{12} = 10\frac{18}{60} - 1\frac{35}{60} = 8\frac{43}{60}$$

$$11. \quad 19\frac{5}{18} - \frac{7}{15} = 19\frac{75}{165} - \frac{77}{165} = 18\frac{163}{165}$$

w. d. h. mi.

$$13. \quad 7 \text{ weeks} = 7 \quad 0 \quad 0 \quad 0$$

$$9\frac{7}{10} \text{ days} = 1 \quad 2 \quad 16 \quad 48$$

Diff. 5 w. 4 d. 7 h. 12 min.

MULTIPLICATION OF VULGAR FRACTIONS.

Page 124.

$$3. \quad \frac{3}{8} \times \frac{4}{5} = \frac{12}{40} = \frac{3}{10}$$

$$4. \quad \frac{2}{5} \text{ of } \frac{3}{4} = \frac{6}{20} = \frac{3}{10} \quad \text{Then, } \frac{3}{10} \times \frac{1}{2} = \frac{3}{20}$$

$$5. \quad 7\frac{1}{2} \times \frac{1}{4} = \frac{15}{2} \times \frac{1}{4} = \frac{15}{8} = 1\frac{7}{8}$$

$$6. \quad \frac{3}{4} \text{ of } 9 = \frac{27}{4} \quad \text{Then, } \frac{27}{4} \times \frac{7}{8} = \frac{189}{32} = 5\frac{29}{32}$$

Page 124.

$$7. 48\frac{3}{5} \times 13\frac{5}{6} = 2\frac{43}{5} \times \frac{83}{6} = 6\frac{723}{10} = 672\frac{3}{10}$$

DIVISION OF VULGAR FRACTIONS.

Page 125.

$$3. \frac{3}{8} \div \frac{6}{7} = \frac{3}{8} \times \frac{7}{6} = \frac{21}{48} = \frac{7}{16} \quad 4. \frac{17}{21} \div \frac{3}{5} = \frac{17}{21} \times \frac{5}{3} = \frac{85}{63} = 1\frac{22}{63}$$

$$5. 1\frac{1}{2} \div 4\frac{8}{10} = \frac{3}{2} \times \frac{5}{24} = \frac{15}{48} = \frac{5}{16} \quad 6. \frac{7}{8} \div 4 = \frac{7}{8} \times \frac{1}{4} = \frac{7}{32}$$

$$7. 9\frac{1}{8} = \frac{55}{8}, \text{ \& } \frac{1}{2} \text{ of } 7 = \frac{7}{2} \text{ Now, } \frac{55}{8} \div \frac{7}{2} = \frac{55}{8} \times \frac{2}{7} = \frac{110}{42} = 2\frac{13}{21}$$

$$8. 5205\frac{1}{3} = 26\frac{026}{3}, \text{ and } \frac{4}{5} \text{ of } 91 = 3\frac{64}{5}$$

$$\text{Now, } 26\frac{026}{3} \div 3\frac{64}{5} = 26\frac{026}{3} \times \frac{5}{364} = 2\frac{6026}{364} = 71\frac{1}{2}$$

RULE OF THREE IN VULGAR FRACTIONS.

$$2. \text{ As } \frac{2}{3} \text{ ton. : } 4\frac{93}{3} \text{ dolls. (=164}\frac{1}{3} \text{ dolls.) : } \frac{6}{7} \text{ ton.}$$

$$\text{Then, } \frac{\cancel{3}}{\cancel{2}} \times \frac{493}{\cancel{3}} \times \frac{\cancel{6}}{7} = \frac{1479}{7} = 211 \frac{284}{7}$$

$$3. \frac{1}{2} \text{ of } \frac{3}{5} = \frac{9}{10}; \text{ Then, As } \frac{9}{10} \text{ : 171 :: 1 : } \frac{19}{\cancel{171}} \times 20 \frac{\text{dolls.}}{\text{dolls.}} = 380$$

$$4. \text{ As } 1 \text{ yd. : } \frac{5}{6} \text{ dolls. :: 42 yds. : } \frac{42 \times 5}{6} \text{ dolls.} = 35$$

$$5. \frac{2}{3} \text{ of } \frac{3}{5} = \frac{4}{5}; \text{ Then say,}$$

$$\text{As } \frac{4}{15} \text{ : 312 : : 1 : } \frac{312 \times 15}{4} \text{ dolls.} = 1170$$

Page 126.

$$6. 1\frac{1}{2} = \frac{4}{3}, 79\frac{1}{2} = 2\frac{38}{3}, \text{ and } 3\frac{2}{5} = \frac{17}{5}$$

$$\text{Now, as } \frac{4}{3} \text{ bu. : } 2\frac{38}{3} \text{ cts. :: } \frac{17}{5} \text{ bu. : } 202\frac{3}{10} \text{ cts.}$$

$$\text{Because, } \frac{\cancel{3}}{4} \times \frac{238}{\cancel{3}} \times \frac{17}{5} = 4\frac{046}{10} = 202\frac{3}{10}$$

$$7. \text{ As } 17535 : \frac{1}{8} :: 60120 : \frac{2}{7}$$

$$\text{Because, } \frac{60120}{17535 \times 8} = \frac{60120}{140280} = \frac{2}{7}$$

8th.

INVERSE PROPORTION.

Page 126.

$$2. \quad 6\frac{1}{2} \text{ cwt.} = \frac{1^3}{2} \text{ cwt. and } 22\frac{2}{3} = \frac{581}{26} \text{ miles}$$

cwt. cwt. mi. miles

$$\text{Now, as } 1 : \frac{1^3}{2} :: \frac{581}{26} : 145\frac{1}{4}$$

$$\text{Because, } \frac{1^3}{2} \times \frac{581}{26} = \frac{581}{2 \times 2} = 145\frac{1}{4} \text{ miles}$$

$$3. \quad \text{As } 16 : 12 :: \frac{188}{5} (=37\frac{3}{5}) : 28\frac{1}{5} \text{ days}$$

$$\text{Because, } \frac{47 \times 3}{5 \times 16} = \frac{141}{5} = 28\frac{1}{5} \text{ days}$$

$$4. \quad 100\frac{2}{3} \text{ dolls.} = \frac{302}{3} \text{ dolls. } 6\frac{2}{3} \text{ mo.} = \frac{20}{3} \text{ months}$$

$$3\frac{1}{3} \text{ years} = \frac{23}{6} \text{ years} = 46 \text{ months}$$

mo. mo. dolls.

$$\text{Then, as } 46 : \frac{20}{3} :: \frac{302}{3} : 141\frac{22}{67} \text{ dollars}$$

$$\text{Because, } \frac{302 \times 20}{46 \times 3 \times 3} = \frac{6040}{414} = 141\frac{22}{67}$$

$$5. \quad \text{As } \frac{7}{3} : \frac{3}{4} :: \frac{41}{2} (=20\frac{1}{2}) : 17\frac{4}{7}$$

$$\text{Because, } \frac{8}{7} \times \frac{3}{4} \times \frac{41}{2} = \frac{3 \times 41}{7} = 17\frac{4}{7} \text{ feet}$$

$$6. \quad 20\frac{1}{2} \text{ yards} = \frac{41}{2} \text{ yards } 1\frac{1}{4} \text{ yard} = \frac{5}{4} \text{ yards}$$

$$\text{Now, as } \frac{3}{4} \text{ yd.} : \frac{5}{4} \text{ yd.} :: \frac{41}{2} \text{ yd.} : 34\frac{1}{6} \text{ yards}$$

$$\text{Because, } \frac{4}{3} \times \frac{5}{4} \times \frac{41}{2} = \frac{205}{3} = 34\frac{1}{6} \text{ yards}$$

INVOLUTION, OR RAISING OF POWERS.

Page 128.

$$2. \quad (35)^4 = 35 \times 35 \times 35 \times 35 = 1500625$$

$$3. \quad (1,03)^3 = 1,03 \times 1,03 \times 1,03 = 1,092727$$

Page 128.

$$4. (,029)^5 = ,029 \times ,029 \times ,029 \times ,029 \times ,029 \\ = ,000000020511149^*$$

$$5. \left(\frac{3}{4}\right)^4 = \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} = \frac{81}{256}$$

SQUARE ROOT.

Page 129.

$$2. \begin{array}{r} 106929 \\ 9 \end{array} (327 \text{ root required})$$

$$\begin{array}{r} 62 \overline{)169} \\ 124 \end{array}$$

$$\begin{array}{r} 647 \overline{)4529} \\ 4529 \end{array}$$

$$3. \begin{array}{r} 4782969 \\ 4 \end{array} (2187 \text{ root required})$$

$$\begin{array}{r} 41 \overline{)78} \\ 41 \end{array}$$

$$\begin{array}{r} 428 \overline{)3729} \\ 3424 \end{array}$$

$$\begin{array}{r} 4367 \overline{)30569} \\ 30569 \end{array}$$

$$4. \begin{array}{r} 43046721 \\ 36 \end{array} (6561 \text{ root required})$$

$$\begin{array}{r} 125 \overline{)704} \\ 625 \end{array}$$

$$\begin{array}{r} 1306 \overline{)7967} \\ 7836 \end{array}$$

$$\begin{array}{r} 13121 \overline{)13121} \\ 13121 \end{array}$$

$$5. \begin{array}{r} 387420489 \\ 1 \end{array} (19683 \text{ root req.})$$

$$\begin{array}{r} 29 \overline{)237} \\ 261 \end{array}$$

$$\begin{array}{r} 386 \overline{)2642} \\ 2316 \end{array}$$

$$\begin{array}{r} 3928 \overline{)32604} \\ 31424 \end{array}$$

$$\begin{array}{r} 39363 \overline{)118089} \\ 118089 \end{array}$$

$$6. \begin{array}{r} 22071204 \\ 16 \end{array} (4698 \text{ root req.})$$

$$\begin{array}{r} 86 \overline{)607} \\ 516 \end{array}$$

$$\begin{array}{r} 929 \overline{)9112} \\ 8361 \end{array}$$

$$\begin{array}{r} 9388 \overline{)75104} \\ 75104 \end{array}$$

$$7. \begin{array}{r} 36372961 \\ 36 \end{array} (6031 \text{ root req.})$$

$$\begin{array}{r} 1203 \overline{)03729} \\ 3609 \end{array}$$

$$\begin{array}{r} 12061 \overline{)12061} \\ 12061 \end{array}$$

*The answer given with the question is the 4th power of ,029.

Page 129.

8. $\overline{2268741}$ (1506,23+root req. 9. $\overline{7596796}$ (2756,228+root req.

1
—
25) 126
125

4
—
47) 359
329

3006) 18741
18036

545) 3067
2725

30122) 70500
60244

5506) 34296
33036

301243) 1025600
903729

55142) 126000
110244

121871 remainder.

551242) 1575600
1102484

5512448) 47311600
44099584

Page 130.

3212016 remainder

10. $\overline{9712,718051}$ (98,553+root req. 11. $\overline{3,17218120}$ (1,78106+root req.

81
—
188) 1612
1504

1
—
27) 217
189

1965) 10871
9825

348) 2821
2784

19705) 104680
98525

3561) 3781
3561

197103) 615551
591309

356206) 2202000
2137236

24242 remainder

64764 remainder

12. $\overline{4795,257310}$ (69,247+root req. 13. $\overline{,00008836}$ (,0094 root req.

36
—
129) 1195
1161

81
—
184) 736
736

1382) 3425
2764

13844) 66173
55376

138487) 1079710
969409

110301

Square root of vulgar fractions.

Page 130.

1. The greatest common divisor is 576

$$576) \frac{2^3 3^6 4}{3^1 18^1} = \frac{4}{9}; \text{ Then, } \sqrt{\frac{4}{9}} = \frac{2}{3}$$

2. The greatest common measure is 169

$$169) \frac{2^7 10^4}{4^2 2^5} = \frac{16}{25}; \text{ Now, } \sqrt{\frac{16}{25}} = \frac{4}{5}$$

3. $\begin{array}{r} \cdot \cdot \cdot \\ 15625(125 \text{ num.} \end{array}$ $\begin{array}{r} \cdot \cdot \cdot \\ 46656(216 \text{ denom.} \end{array}$

$$\begin{array}{r} 1 \\ \hline \end{array}$$

$$\begin{array}{r} 4 \\ \hline \end{array}$$

$$\begin{array}{r} 22)056 \\ 44 \\ \hline \end{array}$$

$$\begin{array}{r} 41)066 \\ 41 \\ \hline \end{array}$$

$$\begin{array}{r} 245)1225 \\ 1225 \\ \hline \end{array}$$

$$\begin{array}{r} 426)2556 \\ 2556 \\ \hline \end{array}$$

That is $\sqrt{\frac{15625}{46656}} = \frac{125}{216}$, root required

Surds.

4. $\frac{357}{476} = .75$; Then, $\sqrt{.75} = .86602$

5. $\frac{478}{339} = .8706739526$ Then, $\sqrt{.8706739526} = .93309$

6. $\frac{387}{738} = .5243902439$ Then, $\sqrt{.5243902439} = .72414$

Square root of mixed numbers.

Page 131.

1. $37\frac{36}{49} = \frac{1849}{49}$ Then, $\sqrt{\frac{1849}{49}} = \frac{43}{7} = 6\frac{1}{7}$

2. $27\frac{9}{16} = \frac{441}{16}$ Then, $\sqrt{\frac{441}{16}} = \frac{21}{4} = 5\frac{1}{4}$

3. $51\frac{21}{25} = \frac{1296}{25}$ Then, $\sqrt{\frac{1296}{25}} = \frac{36}{5} = 7\frac{1}{5}$

4. $94\frac{3}{49} = \frac{484}{49}$ Then, $\sqrt{\frac{484}{49}} = \frac{22}{7} = 3\frac{1}{7}$

Surds.

5. $\sqrt{7\frac{9}{11}} = \sqrt{7.818181 \text{ \&c.}} = 2.7961 +$

6. $\sqrt{8\frac{5}{7}} = \sqrt{8.71428571 \text{ \&c.}} = 2.9519 +$

7. $\sqrt{85\frac{14}{17}} = \sqrt{85.9333 \text{ \&c.}} = 9.27 +$

Any two sides of a right angled triangle given to find the third side.

Page 132.

$$\begin{array}{r} 1. \quad 36 \times 36 = 1296 \\ 27 \times 27 = 729 \\ \hline \end{array}$$

Sum 2025

Now, $\sqrt{2025} = 45$ feet

$$\begin{array}{r} 2. \quad 45 \times 45 = 2025 \\ 60 \times 60 = 3600 \\ \hline \end{array}$$

Sum 5625

Then, $\sqrt{5625} = 75$ yards

$$\begin{array}{r} 3. \quad 45 \times 45 = 2025 \text{ AC squared} \\ 27 \times 27 = 729 \text{ AB squared} \\ \hline \end{array}$$

Diff. 1296 BC squared

Then, $\sqrt{1296} = 36$ feet

$$\begin{array}{r} 4. \quad 75 \times 75 = 5625 \\ 45 \times 45 = 2025 \\ \hline \end{array}$$

Diff. 3600

Then, $\sqrt{3600} = 60$ feet

To find the side of a square equal in area to any given superficies.

Page 133.

$$1. \quad \sqrt{160} = 12,6491106$$

$$2. \quad \sqrt{2025} = 45$$

$$3. \quad \sqrt{750} = 27,3861279$$

To find the diameter of a circle of a given proportion, larger or less than a given one.

$$1. \quad 4 \times 4 = 16, \text{ and } 16 \times 4 = 64 \quad \text{Then, } \sqrt{64} = 8 \text{ feet.}$$

$$2. \quad 100^2 \times 3 = 30000 \quad \text{Then, } \sqrt{30000} = 173,20508 \text{ feet}$$

$$3. \quad \frac{12 \times 12}{2} = 72 \quad \text{Then, } \sqrt{72} = 8,4852814 \text{ inches}$$

The area of a circle given to find the diameter.

RULE. Divide the given area by ,7854 and the quotient is the square of the diameter.

Page 133.

$$1. \quad \sqrt{160 \div ,7854} = \sqrt{203,717850776674} = 14,272976$$

Or, by the rule in the "Calculator."

$$\sqrt{160} = 12,6491106$$

$$1,12837$$

$$885437742$$

$$379473318$$

$$1011928848$$

$$252982212$$

$$1391402166$$

14,272876927722 diameter

2. Because 160 perches is an acre, the diameter is the same as in the foregoing example. Consequently the half diameter, or length of the halter will be

$$14,272976 \div 2 = 7,136488 \text{ perches}$$

$$16\frac{1}{2} \text{ feet}$$

$$114183808$$

$$3568244$$

$$\text{feet } 117,752052$$

$$12$$

$$\text{inches } 9,024624$$

117 feet 9 inches the length of the halter

Application.

Page 134.

$$\text{Quest. 1. } \sqrt{20736} = 144 \text{ men} \quad 2. \quad 25 \times 25 = 625 \text{ feet}$$

$$3. \quad \sqrt{197136} = 444 \text{ stones}$$

4. $600 \div \frac{1}{2} = \frac{600}{\frac{1}{2}} = 1200$ the perpendicular. Because the perpendicular and the other side is the same, viz:—30 perches, the triangle is right angled. Consequently,

$$\sqrt{40^2 + 30^2} = \sqrt{1600 + 900} = \sqrt{2500} = 50 \text{ perches}$$

Page 134.

5. $84 \times 84 = 7056$

$50 \times 50 = 2500$

$\underline{\quad\quad\quad}$
9556

Then, $\sqrt[3]{9556} = 97,7547 + \text{miles}$

6. $\overset{\text{root required}}{964,5192360241(31,05671}$ 7. $\overset{\text{root required}}{1030892198,4001(32107,51}$

9

9

61) 64

61

62) 130

124

6205) 35192

31025

641) 689

641

62106) 416736

372636

64207) 482198

449449

621127) 4410002

4347889

642145) 3274940

3210725

6211341) 6211341

6211341

6421501) 6421501

6421501

CUBE ROOT.

Page 138.

2. $2 \times 2 \times 3 = 12..$

square of 4 = 16

$2 \times 4 \times 30 = 240$

complete divisor $1456 \times 4 =$

$\overset{\text{root required}}{13824(24}$

8

5824

5824

3. $7 \times 7 \times 3 = 147..$

square of 2 = 04

$7 \times 2 \times 30 = 420$

complete divisor $15124 \times 2 = 30248$

$\overset{\text{root required}}{373248(72}$

343

30248

4. $1 \times 1 \times 3 = 3..$

square of 7 = 49

$1 \times 7 \times 30 = 210$

complete divisor $559 \times 7 = 3913$

$17 \times 17 \times 3 = 867..$

square of 9 = 81

$17 \times 9 \times 30 = 4590$

complete divis. $91371 \times 9 = 822339$

$\overset{\text{root required}}{5735339(179}$

1

4735

822339

Page 138

$$\begin{array}{r}
 5. \quad 4 \times 4 \times 3 = 48.. \quad 84604519(439 \text{ root required}) \\
 \text{square of } 3 = 09 \quad 64 \\
 4 \times 3 \times 30 = 360 \quad \underline{\hspace{1cm}} \\
 \hspace{1.5cm} 20604
 \end{array}$$

$$\text{complete divisor } 5169 \times 3 = 15507$$

$$\begin{array}{r}
 43 \times 43 \times 3 = 5547.. \quad 5097519 \\
 \text{square of } 9 = 81 \\
 43 \times 9 \times 30 = 11610 \quad \underline{\hspace{1cm}}
 \end{array}$$

$$\text{comp. divisor } 566391 \times 9 = 5097519$$

$$\begin{array}{r}
 6. \quad 3 \times 3 \times 3 = 27.. \quad 27054036008(3002 \text{ root}) \\
 \text{defective divisor } 2700.. \quad 27 \\
 \text{defective divisor } 270000.. \quad \underline{\hspace{1cm}} \\
 \text{square of } 2 = 04 \quad 054036008 \\
 300 \times 2 \times 30 = 18000 \quad \underline{\hspace{1cm}}
 \end{array}$$

$$\text{complete divisor } 27018004 \times 2 = 54036008$$

$$\begin{array}{r}
 7. \quad 4 \times 4 \times 3 = 48.. \quad 122615327232(4968 \text{ root}) \\
 \text{square of } 9 = 81 \quad 64 \\
 4 \times 9 \times 30 = 1080 \quad \underline{\hspace{1cm}}
 \end{array}$$

$$\text{complete divisor } 5961 \times 9 = 53615$$

$$9^2 \times 2 = 162$$

$$53649$$

$$4966327 \text{ dividend}$$

$$\begin{array}{r}
 \text{defective divisor}^* 7203.. \\
 \text{square of } 6 = 36 \\
 49 \times 6 \times 30 = 8820 \quad \underline{\hspace{1cm}}
 \end{array}$$

$$\text{complete divisor } 729156 \times 6 = 4374936 \text{ subtrahend}$$

$$6^2 \times 2 = 72$$

$$591391232 \text{ dividend}$$

$$\begin{array}{r}
 \text{defective divisor } 738048.. \\
 \text{square of } 8 = 64 \\
 496 \times 8 \times 30 = 119040 \quad \underline{\hspace{1cm}}
 \end{array}$$

$$\text{complete divisor } 73923904 \times 8 = 591391232 \text{ subtrahend}$$

* *Defective divisors*, after the first, may be more concisely found by addition, thus: To the last complete divisor, add the number which completed it, with twice the square of the last figure in the root; the sum will be the next defective divisor:

Page 138.

$$\begin{array}{r}
 8. \quad 2 \times 2 \times 3 = 12.. \quad 22069810125(2805 \text{ root}) \\
 \text{square of } 8 = 64 \quad 8 \\
 2 \times 8 \times 30 = 480 \quad \underline{\hspace{1cm}}
 \end{array}$$

$$\begin{array}{r}
 \text{complete divisor } 1744 \times 8 = 13952 \\
 480 \quad \underline{\hspace{1cm}}
 \end{array}$$

$$8^3 \times 2 = 128 \quad 117810125 \text{ dividend}$$

$$\begin{array}{r}
 \text{defective divisor } 235200.. \\
 \text{square of } 5 = 25 \\
 280 \times 5 \times 30 = 42000
 \end{array}$$

$$\text{complete divisor } 23562025 \times 5 = 117810125 \text{ subtrahend}$$

$$\begin{array}{r}
 9. \quad 6 \times 6 \times 3 = 108.. \quad 219365327791(6031) \\
 \text{defective divisor } 10800.. \quad 216 \\
 \text{square of } 3 = 09 \quad \underline{\hspace{1cm}} \\
 60 \times 3 \times 30 = 5400 \quad 3365327
 \end{array}$$

$$\text{complete divisor } 1085409 \times 3 = 3256227$$

$$\text{square of } 3 \times 2 = 18 \quad 109100791$$

$$\begin{array}{r}
 \text{defective divisor } 1090827.. \\
 \text{square of } 1 = 01 \\
 603 \times 1 \times 30 = 18090
 \end{array}$$

$$109100791 \times 1 = 109100791$$

root required

$$\begin{array}{r}
 10. \quad 8 \times 8 \times 3 = 192.. \quad 673373097125(8765) \\
 \text{square of } 7 = 49 \quad 512 \\
 8 \times 7 \times 30 = 1680 \quad \underline{\hspace{1cm}} \\
 161373
 \end{array}$$

$$\text{complete divisor } 20929 \times 7 = 146503$$

$$\text{twice the sq. of } 7 = 98 \quad 14870097$$

$$\begin{array}{r}
 \text{defective divisor } 22707.. \\
 \text{square of } 6 = 36 \\
 87 \times 6 \times 30 = 15660
 \end{array}$$

$$\text{complete divisor } 2286396 \times 6 = 13718376$$

$$\text{twice the sq. of } 6 = 72 \quad 1151721125$$

$$\begin{array}{r}
 \text{defective divisor } 2302128.. \\
 \text{square of } 5 = 25 \\
 876 \times 5 \times 30 = 131400
 \end{array}$$

$$\text{complete divisor } 230344225 \times 5 = 1151721125$$

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11. $2 \times 2 \times 3 = 12..$ $12,977875(2,35 \text{ root}$
 square of 3 = 09 $\underline{8}$
 $2 \times 3 \times 30 = 180$ $\underline{4977}$
 complete divisor $1389 \times 3 =$ 4167
 180
 twice the sq. of 3 = 18 $\underline{810875}$
 defective divisor 1587..
 square of 5 = 25
 $23 \times 5 \times 30 = 3450$
 complete divisor $162175 \times 5 = 810875$
12. $2 \times 2 \times 3 = 12..$ $15926,972504(25,16+$
 square of 5 = 25 $\underline{8}$
 $2 \times 5 \times 30 = 300$ $\underline{7926}$
 complete divisor $1525 \times 5 =$ 7625
 300
 twice the sq. of 5 = 50 $\underline{301972}$
 defective divisor 1875..
 square of 1 = 01
 $25 \times 1 \times 30 = 750$
 complete divisor $188251 \times 1 = 188251$
 750
 twice the sq. of 1 = 2 $\underline{113721504}$
 defective divisor 189003..
 square of 6 = 36
 $251 \times 6 \times 300 = 45180$
 complete divisor $18945516 \times 6 = 113673096$
 48408 rem.
13. $3 \times 3 \times 3 = 27..$ $36155,027576(33,06$
 square of 3 = 09 $\underline{27}$
 $3 \times 3 \times 30 = 270$ $\underline{9155}$
 complete divisor $2979 \times 3 =$ 8937
 $33 \times 33 \times 3 = 3267..$ $\underline{218027576}$
 defective divisor 326700..
 square of 6 = 36
 $330 \times 6 \times 30 = 59400$
 complete divisor $32729436 \times 6 = 196376616$
 21650966 rem.

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$$\begin{array}{r}
 14. \quad 3 \times 3 \times 3 = 27.. \quad ,053258279(,376 + \text{root} \\
 \text{square of } 7 = 49 \quad 27 \\
 3 \times 7 \times 30 = 630 \quad \underline{\hspace{1cm}} \\
 \text{complete divisor } 3379 \times 7 = 23653 \\
 \hspace{10cm} \underline{\hspace{1cm}} \\
 37 \times 37 \times 3 = 4107.. \quad 2605279 \\
 \text{square of } 6 = 36 \\
 37 \times 3 \times 30 = 3330 \\
 \hspace{10cm} \underline{\hspace{1cm}} \\
 \text{complete divisor } 414066 \times 6 = 2484396 \\
 \hspace{10cm} \underline{\hspace{1cm}} \\
 120883 \text{ remainder}
 \end{array}$$

$$\begin{array}{r}
 15. \quad 1 \times 1 \times 3 = 3.. \quad ,001906624(,124 \text{ root} \\
 \text{square of } 2 = 04 \quad 1 \\
 1 \times 2 \times 30 = 60 \quad \underline{\hspace{1cm}} \\
 \text{complete divisor } 364 \times 2 = 728 \\
 \hspace{10cm} \underline{\hspace{1cm}} \\
 12 \times 12 \times 3 = 432.. \quad 178624 \\
 \text{square of } 4 = 16 \\
 12 \times 4 \times 30 = 1440 \\
 \hspace{10cm} \underline{\hspace{1cm}} \\
 \text{complete divisor } 44656 \times 4 = 178624
 \end{array}$$

$$16. \quad ,000000729(,009 \text{ root required} \\
 729$$

$$\begin{array}{r}
 17. \quad 1 \times 1 \times 3 = 3.. \quad 2,(1,25 + \text{root} \\
 \text{square of } 2 = 04 \quad 1 \\
 1 \times 2 \times 30 = 60 \quad \underline{\hspace{1cm}} \\
 \text{complete divisor } 364 \times 2 = 728 \\
 \hspace{10cm} \underline{\hspace{1cm}} \\
 12 \times 12 \times 3 = 432.. \quad 272000 \\
 \text{square of } 5 = 25 \\
 12 \times 5 \times 30 = 1800 \\
 \hspace{10cm} \underline{\hspace{1cm}} \\
 \text{complete divisor } 45025 \times 5 = 225125 \\
 \hspace{10cm} \underline{\hspace{1cm}} \\
 46875 \text{ remainder}
 \end{array}$$

To extract the cube root of a vulgar fraction.

1. $\frac{250}{136} = \frac{125}{68}$ Then, $\sqrt[3]{\frac{125}{68}} = \frac{5}{4}$ root required
2. $\frac{324}{1500} = \frac{27}{125}$ Then, $\sqrt[3]{\frac{27}{125}} = \frac{3}{5}$ root required
3. $\frac{1520}{136} = \frac{8}{7}$ Then, $\sqrt[3]{\frac{8}{7}} = \frac{2}{\sqrt[3]{7}}$ root required

Surds.

4. $\sqrt[3]{7} = \sqrt[3]{571428571 \text{ \&c.}} = 829 + \text{root required}$
5. $\sqrt[3]{3} = \sqrt[3]{666 \text{ \&c.}} = 873 + \text{root required}$
6. $\sqrt[3]{5} = \sqrt[3]{555 \text{ \&c.}} = 822 + \text{root required}$

To extract the cube root of a mixed number.

1. $\sqrt[3]{31\frac{15}{43}} = \sqrt[3]{\frac{10648}{43}} = \frac{22}{\sqrt[3]{43}} = 3\frac{1}{\sqrt[3]{43}}$
2. $\sqrt[3]{12\frac{19}{27}} = \sqrt[3]{\frac{343}{27}} = \frac{7}{3} = 2\frac{1}{3}$
3. $\sqrt[3]{405\frac{38}{123}} = \sqrt[3]{\frac{50653}{123}} = \frac{37}{\sqrt[3]{123}} = 7\frac{2}{\sqrt[3]{123}}$

Surds.

4. $\sqrt[3]{7\frac{1}{2}} = \sqrt[3]{7,2} = 1,93 + \text{root required}$
5. $\sqrt[3]{8\frac{5}{7}} = \sqrt[3]{8,7142857 \text{ \&c.}} = 2,057 + \text{root required}$
6. $\sqrt[3]{9\frac{1}{6}} = \sqrt[3]{9,166 \text{ \&c.}} = 2,092 + \text{root required}$

To find the side of a cube that shall be equal to any given solid, as a globe, a cone, &c.

1. $\sqrt[3]{10648} = 22$
2. $\sqrt[3]{389017} = 73$

Note.

1. $2^3 \times 3 = 2 \times 2 \times 2 \times 3 = 24$
Then, $\sqrt[3]{24} = 2,8845 \text{ feet} = 2 \text{ feet } 10,614 \text{ inches}$
2. $12^3 \times 3 = 12 \times 12 \times 12 \times 3 = 5184$
Then, $\sqrt[3]{5184} = 17,306 \text{ inches}$
9*

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Application.

Quest. 1. As $6^3 : 3^3 :: 216 : 27 :: 32 \text{ lb.} : 4 \text{ lb.}$

2. $288 \times 216 \times 48 = 2935984$ Then, $\sqrt[3]{2935984} = 144$

3. $\sqrt[3]{389017} = 73$ Then, $73 \times 73 = 5329$

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Quest. 4. Because there is two half feet in a foot.

$$\frac{2 \times 2 \times 2}{2} = \frac{8}{2} = 4 \text{ solid half feet in half a solid foot}$$

And then, $4 - 1 = 3$ solid half feet

5. $2 \times 2 \times 2 = 8$ six inch cubes. And because there are three times 4 inches in a foot we find that there is $3 \times 3 \times 3 = 27$ four inch cubes in a solid foot

ARITHMETICAL PROGRESSION.

Case 1. Page 142.

2. $(\overline{20-1} \times 3) + 3 = (19 \times 3) + 3 = 60$ last term

Then, $(60 + 3) \times \frac{1}{2} = 63 \times 10 = 630$ dollars 30 cents

3. Here 4 is the common difference

And $(\overline{100-1} \times 4) + 4 = (99 \times 4) + 4 = 400$ last term

Then, $(400 + 4) \times \frac{1}{2} = 404 \times 50 = 20200$ yards

But, $20200 \text{ yards} = 11 \text{ miles } 3 \text{ furlongs } 180 \text{ yards}$

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4. $(\overline{10-1} \times 10) + 20 = 90 + 20 = 110$ dollars last term

Then, $(110 + 20) \times \frac{1}{2} = 130 \times 5 = 650$ dollars the whole amount. And $650 \div 10 = 65$ dollars per annum

5. $(\overline{1000-1} \times 10) + 10 = 9990 + 10 = 10000$ cents, or 100 dollars for the last acre

And $(10000 + 10) \times \frac{1}{2} = 50050$ dollars, whole cost

Case 2. Page 143.

2. $\frac{60-20}{21-1} = \frac{40}{20} = 2$ the common difference

Then, 20, 22, 24, 26, 28, &c. are their ages respectively

Page 144.

3. $\frac{58-3}{12-1} = \frac{55}{11} = 5$ miles daily increase

And $(58+3) \times \frac{1}{2} = 61 \times 6 = 366$ miles whole distance

GEOMETRICAL PROGRESSION.

Page 146.

2. Indices 1 2 3 4
Ratio 2, 4, 8, 16, powers of the ratio

In this question the number of terms is 12
 $256 = 8$ th power
 $8 = 3$ d power

$2048 = 11$ th power of the ratio
 $\times 1$ the first term

$2048 = 12$ th or last term of the progression
 $\times 2$ the ratio

4096

Subtract 1 the first term

Ratio $2-1=1$) 4095

$\$4095$ the sum of the series

3. Indices 1 2 3 4 5
Ratio 2, 4, 8, 16, 32, powers of the ratio

Here the number of terms is 15
 $1024 = 10$ th power
 $16 = 4$ th power

$16384 = 14$ th power of the ratio.

And because the first term of the progression is 1, the 14th power of the ratio is the last, or 15th term of the progression

Then, $\frac{(16384 \times 2 \text{ ratio}) - 1}{\text{ratio } 2-1} = \$2767 \text{ shillings} = 1688 \text{ l. } 11 \text{ s.}$

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4. Indices 1 2 3 4
 Ratio 4, 16, 64 256 powers of the ratio
 256

Here the number of terms is 12
 1536
 1280
 512
 65536=8th power
 64=3d power

262144
 393216
 4194304=11th power of the ratio,
 which is also the 12th or last term of the progression.

Then, $\frac{(4194304 \times 4) - 1}{4 - 1} = 55924$ ^{dolls} ^{cts.} 05 sold for

And $12 \times 20 = 240$ 00 cost
 855684 05 gain

5. Indices 1 2 3 4 5 6 7
 Ratio 2, 4, 8, 16, 32, 64, 128, powers of the ratio
 128

Here the number of terms is 32
 1024
 256
 128

16384=14th power
 26384= do.

65536
 131072
 49152
 98304
 16384

268435456=28th power
 8=3d power

2147483648=31st power of the ratio: And because the first term of the progression is 1, it is also the 32d or last term of the progression

Then, $\frac{(2147483648 \times 2) - 1}{2 - 1} = 4294967$ d. 29 cts. 5 ms.
 2-1 Ratio

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6. Indices 1 2 3 4 5
Ratio 3, 9, 27, 81, 243 powers of the ratio

$$\begin{array}{r}
 243 \\
 \hline
 729 \\
 972 \\
 486 \\
 \hline
 59049 = 10\text{th power} \\
 59049 = \text{do} \\
 \hline
 531441 \\
 236196 \\
 5314410 \\
 295245 \\
 \hline
 3486784401 = 20\text{th power} \\
 59049 = 10\text{th power} \\
 \hline
 31381059609 \\
 13947137604 \\
 313810596090 \\
 17433922005 \\
 \hline
 205891132094649 = 30\text{th power} \\
 3 = \text{single power}
 \end{array}$$

$$617673396283947 = 31\text{st power of the ratio, or}$$

32d term of the progression

Then, $\frac{(617673396283947 \times 3) - 1}{\text{Ratio } 3 - 1} = 926510094425 \text{ d. } 92 \text{ c.}$

$$7. \quad 1 \times \frac{(4^{32} - 1)}{4 - 1} = \frac{18446744073709551615}{3} =$$

6148914691236517 dollars 20 cents 5 mills

$$8. \quad 2 \times \frac{(3^{30} - 1)}{3 - 1} = \frac{2 \times 205891132094648}{2} =$$

205891132094648 pins Which at 1000 for a farthing
amounts to £.214466929 5 3½

cost of 30 yards at £100 = 3000 0 0

gain £.214466929 5 3½

SINGLE POSITION.

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3. Suppose A paid 12 dollars

Then B 4 ‘

And C 1 ‘

 17 sum

dolls. $\left\{ \begin{array}{l} 12 : 240 \text{ A paid} \\ 4 : 80 \text{ B} \\ 1 : 20 \text{ C} \end{array} \right.$

Now, as 17 : 340 ::

4. Suppose 60

 $\frac{1}{4} = 15$

$\frac{1}{5} = 12$

$\frac{1}{6} = 10$

 37

Now, as 37 : 60 :: 148 : $\frac{148 \times 60}{37} = 240$ d.

5. Suppose 12

 $\frac{1}{2} = 6$

$\frac{1}{3} = 4$

 10

 left 2

6. Suppose A's age 6

Then, B's = $6 \times 1\frac{1}{2} = 9$ And C's = $(6+9) \times 2\frac{1}{5} = 31\frac{1}{2}$

 $46\frac{1}{2}$

Then, as 46,5 : 93 :: $\left\{ \begin{array}{l} 6 : 12 \text{ A's age} \\ 9 : 18 \text{ B's} \\ 31,5 : 63 \text{ C's} \end{array} \right.$

7. Suppose 1 to be the number

Then, $\frac{2}{5} - \frac{1}{5} = \frac{35-32}{40} = \frac{3}{40}$ difference

Now, as $\frac{3}{40} : 1 :: 6 : \frac{6 \times 40}{3} = 80$

Page 148.

8. Suppose 1 the harness
then 2 ' horse
and 6 ' chaise

JOSEPH B HAMMOND

$$\begin{array}{r} \text{Then, as } 9 : 360 :: \left\{ \begin{array}{l} 1 : 40 \text{ dollars harness} \\ 2 : 80 \text{ dollars horse} \\ 6 : 240 \text{ dollars chaise} \end{array} \right. \end{array}$$

$$\begin{array}{r} 9. \text{ Suppose } 60 \\ \hline \frac{1}{3} = 20 \\ \frac{1}{4} = 15 \\ \frac{1}{5} = 12 \\ \frac{1}{6} = 10 \\ \hline 57 \end{array}$$

$$\begin{array}{r} 10. \text{ Suppose } 12 \\ \hline \frac{1}{3} = 4 \\ \hline \text{A spends } 8 \\ \hline 2 \\ \hline \text{B spends } 16 \\ \hline 12 \\ \hline \text{B sinks } 4 \end{array}$$

$$\begin{array}{l} \text{dolls. dolls.} \qquad \qquad \qquad \text{dolls. dolls.} \\ \text{Now, as } 57 : 60 :: 228 : 240 \text{ Then, as } 4 : 12 :: 50 : 150 \end{array}$$

DOUBLE POSITION.

Page 150.

$$\begin{array}{r} 2. \text{ Suppose } 8 \\ \hline \frac{1}{3} = 1 \end{array}$$

$$\begin{array}{r} \text{Again, suppose } 40 \\ \hline \frac{1}{3} = 5 \end{array}$$

$$\begin{array}{r} \text{A spends } 7 \\ \hline 30 \end{array}$$

$$\begin{array}{r} \text{A spends } 35 \text{ per year} \\ \hline 30 \end{array}$$

$$\begin{array}{r} \text{B spends } 37 \text{ per year} \\ \hline 8 \end{array}$$

$$\begin{array}{r} \text{B spends } 65 \text{ per year} \\ \hline 8 \end{array}$$

$$\begin{array}{r} \text{B spends } 296 \text{ in 8 years} \\ 8 \times 8 = 64 \end{array}$$

$$\begin{array}{r} \text{B spends } 520 \text{ in 8 yrs.} \\ 40 \times 8 = 320 \end{array}$$

$$\begin{array}{r} \text{B is indebted } 232 \\ \hline 40 \end{array}$$

$$\begin{array}{r} \text{B is indebted } 200 \\ \hline 40 \end{array}$$

192 error too little

160 e. too lit.

$$192 \text{ error} \times 40 = 7680$$

$$160 \text{ error} \times 8 = 1280$$

$$\begin{array}{l} 6400 \text{ difference of the products} \\ 192 - 160 = 32 \text{ the difference of the errors} \end{array}$$

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Question 2d continued.

Then, $6400 \div 32 = 200$ dollars their income.And $200 - \frac{2}{3} = 200 - 25 = 175$ dolls. A spends per annumAlso, $175 + 30 = 205$ dollars B spends per annum

3. Suppose A's 12
 Then B's is 15
 And C's ' 19

46
 100

Error 54 too little

$$54 \times 40 = 2160$$

$$30 \times 12 = 360$$

2520 sum of the productsAnd $54 + 30 = 84$ sum of the errorsThen, $2520 \div 84 = 30$ A's share $30 + 3 = 33$ B's share $33 + 4 = 37$ C's share

Again, suppose A's 40
 Then B's is 43
 And C's ' 47

130
 100

Error 30 too much

4. Suppose A paid 100
 then B ' 1100
 and C ' 1200

2400
 10000

error 7600

Again, suppose A paid 200
 then B ' 1200
 and C ' 1400

2800
 10000

error 7200

Errors are alike, i. e. both too little

$$7600 \times 200 = 1520000$$

$$7200 \times 100 = 720000$$

Diff. of the products, 800000

 $7600 - 7200 = 400$ difference of the errorsThen, $800000 \div 400 = 2000$ dollars A paidAnd $2000 + 1000 = 3000$ dollars B paidAlso $2000 + 3000 = 5000$ dollars C paid

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5. Suppose first horse \$10 Again, sup. first horse \$20

50

50

2)60

2)70

The second horse 30

Then, second horse 35

50

50

80

85

10×3=30

20×3=60

Error too little 50

error too little 25

50×20=1000

50

25×10= 250

25

Diff. of the prod. 750 Diff. of the errors 25

Then, $750 \div 25 = 30$ dollars first horseAnd $\frac{30+50}{2} = 40$ dollars second horse

6. Suppose 20 body Again, suppose 30 body

Then, $\frac{3}{2} + 9 = 19$ tail
9 head

Then, $\frac{3}{2} + 9 = 24$ tail
9 head

Head and tail=28
body=20

Head and tail 33
body 30

error 8 too little

error 3 too little

30×8=240

8—3=5 difference of the errors

20×3= 60

Then, $180 \div 5 = 36$ inches the body
Diff. of pro. 180 And $\frac{3}{2} + 9 = 27$ tail
9 head

72 in.=6 feet.

Page 150.

7. Suppose he wrought 20 days, and was idle 20

Then, 20 days \times 20 cents = 40020 ' \times 10 ' = 200

 He would receive 200 cents
 500

 error too little 300

Again, suppose he wrought 25 days, and was idle 15

Then, 25 days \times 20 cents = 50015 ' \times 10 ' = 150

 He would receive 350
 500

 error 150 too little
 $25 \times 300 = 7500$ $20 \times 150 = 3000$ $300 - 150 = 150$ difference of the errors

Diff. of pro. 4500

Then, $4500 \div 150 = 30$ days, wroughtAnd $40 - 30 = 10$ days, idle

8. Suppose each had 300 dollars

Then, $300 + \frac{300}{4} = 300 + 75 = 375$ And $(300 - 225) \times 2 = 75 \times 2 = 150$

 Difference 225 error

Again, suppose each had 400 dollars

Then, $400 + \frac{400}{4} = 400 + 100 = 500$ And $(400 - 225) \times 2 = 175 \times 2 = 350$

 Difference 150 err.

Errors alike

Now, $400 \times 225 = 90000$ And $300 \times 150 = 45000$

 Diff. of the products 45000
And $225 - 150 = 75$ difference of the errorsThen, $4500 \div 75 = 600$ dollars

Page 150.

9. Suppose the parts to be 8 and 7 Again, suppose the parts to be 10 and 5

$$\begin{aligned} \text{Then, } 8 \times 4 &= 32 \\ 7 \times 16 &= 112 \end{aligned}$$

$$\begin{aligned} \text{Then, } 10 \times 4 &= 40 \\ 5 \times 16 &= 80 \end{aligned}$$

80 error

40 error

Errors alike.

$$10 \times 80 = 800$$

$$80 - 40 = 40 \text{ difference of the errors}$$

$$8 \times 40 = 320 \quad \text{Then, } 480 \div 40 = 12 \text{ the greater}$$

$$\text{Diff. of pro. } 480$$

$$\text{And } 15 - 12 = 3 \text{ the less}$$

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10. Suppose 1 o'clock

$$\text{Then, } (\frac{2}{13} \text{ of } 11) \div 1 = \frac{22-13}{13} = \frac{9}{13} \text{ error}$$

Again, suppose it to be two of the clock

$$\text{Then, } (\frac{2}{13} \text{ of } 10) \div 2 = \frac{26-20}{13} = \frac{6}{13} \text{ error}$$

Errors unlike

$$\text{Now, } \frac{9}{13} \times 2 = \frac{18}{13}, \text{ and } \frac{6}{13} \times 1 = \frac{6}{13}$$

$$\text{Then, } \frac{18}{13} + \frac{6}{13} = \frac{24}{13} \text{ the sum of the products}$$

$$\text{And } \frac{9}{13} + \frac{6}{13} = \frac{15}{13} \text{ the sum of the errors}$$

$$\text{Lastly, } \frac{24}{13} \div \frac{15}{13} = \frac{24}{13} \times \frac{13}{15} = \frac{24}{5} = 4 \frac{4}{5} = 1 \text{ hour } 36 \text{ minutes.}$$

PERMUTATION.

2.

$$1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 \times 10 \times 11 \times 12 = 479001600 \text{ changes}$$

$$10) 479001600 \text{ changes}$$

$$\begin{array}{r} \text{days hrs. } 6,0) \overline{47900160} \\ 365 \quad 6=8766) \quad 798336 \text{ (91 years} \\ \quad \quad \quad 78894 \end{array}$$

$$\underline{9396}$$

$$8766$$

$$\text{--- days w. d.}$$

$$24) 630 (26=3 \quad 5$$

$$\underline{48}$$

$$150$$

$$\underline{144}$$

6 hours.

Ans. 91 years 3 weeks 5 days 6 hours

3. $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 = 5040$ days.
Then, $5040 \div 365 = 13$ years 295 days

Page 152.

4. $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 = 362880$

5. $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 \times 10 \times 11 \times 12 \times 13 \times 14 \times 15$
 $\times 16 \times 17 \times 18 \times 19 \times 20 \times 21 \times 22 \times 23 \times 24 \times 25 \times 26 =$
 $403291461126605635584000000$

COMBINATION.

$$\begin{array}{r} 1174 \\ 24 \times 23 \times 22 \times 21 \times 20 \times 19 \\ \hline 1 \times 2 \times 3 \times 4 \times 5 \times 6 \\ \hline 4 \times 23 \times 11 \times 7 \times 19 = 134596 \end{array}$$

$$5 \quad 4 \quad 13 \quad 5 \quad 3$$

$$30 \times 29 \times 28 \times 27 \times 26 \times 25 \times 24 \times 23$$

$$1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8$$

$$5 \times 29 \times 27 \times 13 \times 5 \times 23 = 5852925$$

ADDITION OF DUODECIMALS.

Page 153.

	feet	in.	"	"	"	"
2.	3780	9	4	7	9	

SUBTRACTION OF DUODECIMALS.

Page 154.

2. 916 feet 8 inches 1 second 8 thirds 2 fourths

	<i>ft. in. " ' "</i>		<i>ft. in. " ' " "</i>
5.	From 35 9 2 0		From 803 3 4 0 0
	Take 24 10 5 5		Take 70 3 7 10 0
	<hr/>		<hr/>
	Diff. 10 10 8 7		Diff. 732 11 8 1 8

MULTIPLICATION OF DUODECIMALS.

Case 1. Page 155.

<p>2. $\begin{array}{r} \text{ft. in.} \\ 9 \ 5 \\ 3 \ 11 \\ \hline 8 \ 7 \ 7 \\ 28 \ 3 \\ \hline \end{array}$</p> <p>square ft. 36 10 7</p>	<p>3. $\begin{array}{r} \text{ft. in.} \\ 7 \ 10 \\ 8 \ 11 \\ \hline 7 \ 2 \ 2 \\ 62 \ 8 \\ \hline \end{array}$</p> <p>sq. ft. 69 10 2</p>	<p>4. $\begin{array}{r} \text{ft. in.}'' \\ 8 \ 4 \ 6 \\ 2 \ 7 \ 4 \\ \hline 2 \ 9 \ 6 \\ 4 \ 10 \ 7 \ 6 \\ 16 \ 9 \ 0 \\ \hline \end{array}$</p> <p>square feet 21 10 5 0</p>
---	---	---

5. $\begin{array}{r} \text{feet in.} \\ 5 \ 7 \\ 1 \ 10 \\ \hline 4 \ 7 \ 10 \\ 5 \ 7 \\ \hline \end{array}$

square ft. 10 2 10

Then, 150 cents
10 square feet

$\begin{array}{r} 2 \text{ in.} \\ 8 \text{ ''} \\ 2 \text{ ''} \end{array} \left \begin{array}{l} \frac{1}{3} \\ \frac{1}{3} \\ \frac{1}{3} \end{array} \right $	$\begin{array}{r} 1500 \\ 25 \\ 8\frac{1}{3} \\ 2\frac{1}{3} \\ \hline \end{array}$
--	---

\$15,35\frac{5}{12}

6. $\begin{array}{r} \text{ft. in.} \\ 7 \ 10 \\ 6 \ 8 \\ 5 \ 4 \\ \hline 19 \ 10 \\ 3 \ 11 \\ \hline 18 \ 2 \ 2 \\ 59 \ 6 \\ \hline 77 \ 8 \ 2 \\ 3 \end{array}$

Then, 233 square feet
14 cents

6 is $\frac{1}{24} = \frac{7}{12}$

3262

\$32,62\frac{7}{12}

233 0 6 square feet
10⁺

Case 2. Page 156.

2.	<i>ft.</i> <i>in.</i> 76 7×1 6	3.	<i>ft.</i> <i>in.</i> 127 6×2 10	4.	<i>ft.</i> <i>in.</i> 184 8×7 12
	<hr/> 459 6 3		<hr/> 1275 0 9		<hr/> 2216 0 10
	<hr/> 1378 6		<hr/> 11475 0		<hr/> 22160 0
<i>in.</i>	76 7	<i>in.</i>	255 0	<i>in.</i>	1292 8
6 is $\frac{1}{2}$ =	38 3 6	4 is $\frac{1}{2}$ =	42 6	6 is $\frac{1}{2}$ =	92 4
4 ' $\frac{1}{2}$ =	25 6 4		<hr/> 11772 6		<hr/> sq. feet 23545 0
sq. ft.	1518 10 10				

Page 157.

6.	<i>feet</i> <i>in.</i> 38 11 10	7.	<i>feet</i> <i>in.</i> 59 9 4
	<hr/> 389 2 7		<hr/> 239 0 6
	<hr/> 2724 2		<hr/> 1434 0
6 in. is $\frac{1}{2}$ =	19 5 6	6 in. is $\frac{1}{2}$ =	29 10 $\frac{1}{2}$
2 ' ' $\frac{1}{2}$ =	6 5 10		<hr/> 9)1463 10 $\frac{1}{2}$
square feet	2750 1 4		<hr/> 162 yds. 5 ft. 10 $\frac{1}{2}$ in.
8.	<i>feet</i> <i>in.</i> <i>feet</i> 54 9 = 54,75 58 6 = 58,5	9.	<i>feet</i> <i>in.</i> 7 6 3 3
	<hr/> 27375 43800 27375		<hr/> 1 10 6 22 6
	<hr/> 9)3202,875		<hr/> 24 4 6 1 10
	<hr/> 355,875 yards 15 cents		<hr/> 20 3 9 0 24 4 6
	<hr/> \$53,38125		<hr/> square feet 44 8 3 0

Page 157.

10.
$$\begin{array}{rcll} \text{ft. in.} & \text{ft. in.} & \text{ft. in.} & \text{ft. in.} \\ (2 \ 10) \times (2 \ 4) \times (1 \ 9) & = & 11 \ 6 \ 10 \\ (2 \ 10) \times (2 \ 6) \times (1 \ 3) & = & 8 \ 10 \ 3 \\ (3 \ 6) \times (2 \ 2) \times (1 \ 8) & = & 12 \ 7 \ 8 \\ (2 \ 10) \times (2 \ 8) \times (1 \ 9) & = & 13 \ 2 \ 8 \\ (2 \ 10) \times (2 \ 6) \times (1 \ 9) & = & 12 \ 4 \ 9''' \\ (2 \ 11) \times (2 \ 8) \times (1 \ 8) & = & 12 \ 11 \ 6 \ 8 \end{array}$$

71 7 8 8

Or, 71,6435 square feet

ft. dolls. *sq. feet.*

Then, as 40 : 20 ∴ 2 : 1 :: 71,6435 : \$35,82+

To find a ship's tonnage.

Page 158.

3.
$$\frac{64 \times 22 \times 10}{95} = \frac{14080}{95} = 148 \frac{4}{19} \text{ tons}$$

4.
$$\frac{80 \times 26 \times 13}{95} = \frac{27040}{95} = 284 \frac{12}{19} \text{ tons}$$

THE CARPENTERS' OR SLIDING RULE.

Page 160.

1st. To multiply numbers together.

2. Set 1 on B to 12 on A, then against 16 on B stands 192 the product on A.

3. Set 1 on B to 35 on A, then against 19 on B stands 665 the product on A.

4. Set 1 on B to 54 on A, then against 270 on B stands 14580 the product on A.

2d. Division of numbers by the Carpenters' rule.

2. Set the divisor 19 on B to the dividend 665 on A, then against 1 on B stands 35 the quotient on A.

3. Set 27 on B to 396 on A, then against 1 on B stands 14,6 the quotient on A.

Page 160.

4. Set 42 on B to 741 on A, then against 1 on B stands 17,6 the quotient on A.

5. Set 24 on B to 7680 on A, then against 1 on B stands 320 the quotient on A.

3d. *To square numbers by the Carpenters' rule.*

♣
Page 161.

2. Having set 1 on C to 10 on D, then against 30 on D stands 900 on C.

3. Having the rule set as above, against 35 on D you will find 1225 its square on C.

4. Also against 40 on D stands 1600 its square on C.

4th. *To find a fourth proportional to three numbers.*

2. Set the first term 25 on B to 75 the second term on A, then against 100 the third term on B stands 300 the fourth term on A.

3. Set 27 on B to 20 on A, then against 73 on B stands $54\frac{2}{3}$ on A.

5th. *To extract the square root of any number by the Carpenters' rule.*

2. Having set 1 on C to 10 on D, against 529 on C stands 23 its root on D.

3. Being set as in the last example, against 900 on C stands 30 the root on D.

4. The rule set as before, against 300 on C stands 17,3 the root on D.

MEASURING OF BOARDS AND TIMBER.

Page 162.

1st. *To find the superficial content of a board or plank.*

$$\begin{array}{r}
 \text{foot in.} \\
 2. \quad \begin{array}{r} 1 \ 2 \\ 12 \ 6 \\ \hline 7 \ 0 \\ 14 \ 0 \\ \hline \end{array}
 \end{array}$$

Or, by the sliding rule.

As 12 on B : 14 on A ::

12 ft. 6 in. on B : 14 ft.

7 in. on A*.

feet 14 7

$$3. \quad 13\frac{1}{2} + 13\frac{1}{2} + 14\frac{1}{2} + 18 + 11\frac{1}{4} = 70\frac{3}{4} = 2\frac{3}{4} \text{ inches}$$

$$\text{But } 2\frac{3}{4} \text{ inches} = \frac{283}{4 \times 12} \text{ feet } \frac{283}{48} \text{ feet}$$

$$\text{And } 17\frac{1}{2} \text{ feet} = 3\frac{5}{2} \text{ feet}$$

$$\text{Then, } \frac{283}{48} \times \frac{35}{2} \times 3 \text{ cts.} = \frac{9905 \times 3}{96} = \frac{29715}{96} = 3\text{d. } 09\frac{1}{2} \text{ cts.}$$

2d. *Having the breadth of a board or plank in inches, to find how much in length will make a foot, &c.*

Page 163.

$$2. \quad 144 \div 23 = 6,26 \text{ inches}$$

$$3. \quad 1\frac{1}{2} \text{ yards} = 1944 \text{ square inches}$$

$$\text{Then, } 1944 \div 26 = 74,7692 \text{ inches} = 6,2307 \text{ feet}$$

3d. *To find the solid content of square or four sided timber.*

Page 164.

$$2. \quad \frac{15 \text{ in.} \times 15 \text{ in.} \times 18 \text{ ft.}}{144} = 2\frac{3}{8} = 28\frac{1}{8} \text{ feet}$$

$$3. \quad \frac{25 \text{ in.} \times 9 \text{ in.}}{2} = 17 \text{ inches, the quarter girt}$$

$$\text{Then, } \frac{17 \text{ in.} \times 17 \text{ in.} \times 20 \text{ ft.}}{144} = 40,1388 \text{ feet, \&c.}$$

*The operation by the sliding rule is omitted after this, it being presumed that the directions in the W. Calculator make it superfluous to work more examples.

Page 164.

$$4. \frac{32\text{in.} + 10\text{in.}}{2} = 21 \text{ inches the mean breadth}$$

$$\text{And } \frac{20\text{in.} + 6\text{in.}}{2} = 13 \text{ inches the mean breadth}$$

$$\text{Then, } \frac{21 \times 13 \times 18}{8} = 2\frac{1}{2} = 34,125 \text{ feet}$$

4th. *To find the solid content of round timber.*

Page 165.

$$2. \frac{14 \times 2}{2 \times 4} = 2 \text{ the quarter girt}$$

$$\text{Then, } 2 \times 2 \times 24 = 96 \text{ feet.}$$

Page 166.

$$3. 24 \text{ inches} = 2 \text{ feet}$$

$$\text{Then, } 2 \text{ feet} \times 2 \text{ feet} \times 18 \text{ feet} = 72 \text{ feet.}$$

$$4. \frac{11 \text{ ft. } 4 \text{ in.} + 2 \text{ ft. } 8 \text{ in.}}{2 \times 4} = 1\frac{1}{2} = 1,75 \text{ feet}$$

$$\text{Then, } 1,75 \text{ ft.} \times 1,75 \text{ ft.} \times 21 \text{ ft.} = 64,3125 \text{ feet}$$

$$\begin{aligned} 5. \quad 24 \times \left(\frac{3}{4}\right)^2 &= 24 \times 4 && = 96 \\ 14\frac{1}{2} \times \left(\frac{3}{4}\right)^2 &= 14,5 \times 6,2015625 && = 8,9922 + \\ 17\frac{1}{4} \times \left(\frac{3}{4}\right)^2 &= 17,25 \times 2,4649 && = 42,5195 \end{aligned}$$

sum 147,5117 feet

CARPENTERS' AND JOINERS' WORK.

Page 168.

$$2. \frac{(53\text{ft. } 6\text{in.}) \times (47\text{ft. } 9\text{in.})}{100} = \frac{53,5 \times 47,75}{100} = 25 \frac{\text{sq. feet}}{54,625}$$

$$3. \frac{(36 \text{ ft. } 3 \text{ in.}) \times (16 \text{ ft. } 6 \text{ in.})}{100} = \frac{36,25 \times 16,5}{100} = 5,98125 \text{ squares}$$

$$\text{Then, } 5,98125 \text{ squares} \times 4 \text{ d. } 50 \text{ c.} = 26 \text{ d. } 91 \text{ c. } 5,625 \text{ m.}$$

Page 168.

4. $55 \text{ ft.} \times 30 \text{ ft.} = 1050 \text{ square feet}$
 $(4 \text{ ft. } 6 \text{ in.}) \times 6 \text{ ft.} = 4,5 \times 6 = 27 \text{ square ft. fire place}$
 $(10 \text{ ft. } 6 \text{ in.}) \times 8 \text{ ft.} = 10,5 \times 8 = 84 \text{ ' ' stairs}$

111 feet

Then, $\frac{1050 - 111}{100} = 9,39 \text{ squares}$

Lastly, $9,39 \text{ squares} \times 3 \text{ d. } 75 \text{ c.} = 35 \text{ d. } 21 \text{ c. } 2,5 \text{ ms.}$

$$5. \frac{\begin{array}{c} \text{ft. in.} \\ (82 \text{ } 6) \end{array} \times \begin{array}{c} \text{ft. in.} \\ (12 \text{ } 3) \end{array}}{100} = \frac{\begin{array}{c} \text{ft.} \\ 82,5 \end{array} \times \begin{array}{c} \text{ft.} \\ 12\frac{3}{4} \end{array}}{100} = 10 \text{ } 10,625 \text{ sq. feet}$$

$$6. \frac{(91 \text{ ft. } 9 \text{ in.}) \times (11 \text{ ft. } 3 \text{ in.})}{100} = \frac{91,75 \times 11\frac{3}{4}}{100} = 10,321875 \text{ squares.}$$

Then, $\begin{array}{c} \text{squares} \\ 10,321875 \end{array} \times 4 \text{ } 50 = \begin{array}{c} \text{dolls. cts. d. cts. mills} \\ 46 \text{ } 44 \text{ } 8,4375 \end{array}$

Page 169.

$$8. \begin{array}{r} \text{ft. in.} \\ 2)30 \text{ } 6 \\ \underline{15 \text{ } 3} \end{array}$$

$45 \text{ } 9 = 45,75 \text{ feet. And } 52 \text{ feet } 8 \text{ in.} = 52\frac{2}{3} \text{ feet}$

Then, $\frac{45,75 \times 52\frac{2}{3}}{100} = 24,095 \text{ squares}$

Lastly, $24,095 \text{ sq.} \times 140 \text{ cts.} = 33 \text{ dolls. } 75 \text{ cts. } 3 \text{ mills}$

$$9. \begin{array}{r} \text{feet in.} \\ 20 \text{ } 6 \\ \frac{1}{4} = 10 \text{ } 3 \end{array}$$

$30 \text{ } 9 = 30,75 \text{ feet. And } 40 \text{ feet } 6 \text{ inches} = 40,5 \text{ feet}$

Then, $\frac{30,75 \times 40,5}{100} = 12,45375 \text{ squares}$

Lastly, $12,45375 \text{ squares} \times 225 \text{ cts.} = 28 \text{ dollars } 2 \text{ cents } +$

Page 170.

$$11. (137 \text{ ft. } 6 \text{ in.}) \times (16 \text{ ft. } 3 \text{ in.}) = 137,5 \times 16\frac{1}{4} = 2234,375 \text{ square feet}$$

Then, $2234,375 \text{ feet} \div 9 = 248 \text{ yards } 2,375 \text{ feet}$

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$$12. (69 \text{ ft. } 9 \text{ in.}) \times (6 \text{ ft. } 3 \text{ in.}) = 69,75 \times 6\frac{1}{4} = 435,9375$$

$$\frac{1}{2} \text{ work} = 217,96875$$

$$\underline{9)653,90625}$$

square yards 72,65625

$$13. (83 \text{ ft. } 8 \text{ in.}) \times (12 \text{ ft. } 6 \text{ in.}) = 83\frac{2}{3} \times 12,5 = 1045,83\frac{1}{3}$$

$$(7 \text{ ft. } 8 \text{ in.}) \times (2 \text{ ft. } 6 \text{ in.}) \times 1\frac{1}{2} = 7\frac{2}{3} \times 2,5 \times 1,5 = 28,75 \text{ wind.}$$

$$(3 \text{ ft. } 6 \text{ in.}) \times 7 \text{ ft.} \times \frac{1}{2} = 3,5 \times 7 \times,5 = 12,25 \text{ door}$$

$$\underline{9)1086,83\frac{1}{3}}$$

square yards 120,7 $\frac{16}{27}$ Then, 120,7 $\frac{16}{27}$ yds. \times 80 cts. = 96 dolls. 60 cts. 7 $\frac{11}{27}$ mills

BRICKLAYERS' WORK.

Page 173.

$$2. \begin{array}{cc} \text{ft. in.} & \text{ft. in.} \\ (57 \ 3) \times (24 \ 6) \times 5 = 57,25 \times 24,5 \times 5 = 7013,125 \end{array} \quad \text{half brick}$$

Then, 3)7013,125

$$\underline{9)2337,708\frac{1}{3}} \text{ standard thickness}$$

259,745 + square yards

$$\text{Or, } 2337,708\frac{1}{3} \div 272\frac{1}{4} = 8,5866 \text{ rods}$$

$$3. \begin{array}{cc} \text{feet in.} & \text{feet in.} \\ (245 \ 9) \times (16 \ 6) \times 5 = 245,75 \times 16,5 \times 5 = 20274,375 \end{array}$$

And 20274,375 \div 3 = 6758,125 standard thickness

$$\text{Then, } \frac{6758,125}{272,25} = 24 \text{ rods } 3 \text{ quarters } 19,945 \text{ feet}$$

$$4. (45 \text{ ft.} \times \frac{1}{2} \text{ ft.} \times 5) \div 3 = 562,5 \text{ standard thickness}$$

$$\text{Then, } 562,5 \div 272,25 = 2 \text{ rods } 18 \text{ feet}$$

MASONS' WORK.

Page 175.

$$2. \begin{array}{cc} \text{feet in.} & \text{feet in.} \\ (53 \ 6) \times (12 \ 3) \times 2 = 53,5 \times 12\frac{1}{4} \times 2 = 1310,75 \text{ feet} \end{array}$$

$$\text{Then, } 1310,75 \div 24,75 = 52,9595 \text{ rods}$$

Page 175.

$$3. (107 \text{ ft. } 9 \text{ in.}) \times (20 \text{ ft. } 6 \text{ in.}) = 2208 \text{ feet } 10\frac{1}{2} \text{ inches}$$

$$4. \frac{(112 \text{ ft. } 3 \text{ in.}) \times (16 \text{ ft. } 6 \text{ in.})}{63} = \frac{112,25 \times 16,5}{63} = \frac{\text{rods feet}}{29 \text{ } 25,125}$$

$$5. (5 \text{ ft. } 7 \text{ in.}) \times (1 \text{ ft. } 10 \text{ in.}) = \frac{67}{12} \times \frac{22}{12} = \frac{1474}{144} = \frac{737}{72} \text{ feet}$$

$$\text{Then, } \frac{737}{72} \times 80 \text{ cts.} = \frac{737 \times 10}{9} = 818\frac{8}{9} \text{ cts.} = 8 \text{ dolls. } 18\frac{8}{9} \text{ cts.}$$

PLASTERERS' WORK.

Page 177.

$$2. \frac{\frac{\text{feet in.}}{(141 \text{ } 6)} \times \frac{\text{feet in.}}{(11 \text{ } 3)}}{9} = \frac{141.5 \times 11,25}{9} = \frac{\text{yards}}{176,875}$$

$$3. (22 \text{ ft. } 7 \text{ in.}) \times (13 \text{ ft. } 11 \text{ in.}) = \frac{271}{12} \times \frac{167}{12} = \frac{45257}{144} \text{ feet}$$

$$\text{But, } \frac{45257}{144} \text{ feet} = \frac{45257}{144 \times 9} = \frac{45257}{1296} \text{ yards}$$

$$\text{Then, } \frac{45257}{1296} \times 15 \text{ cts.} = \frac{226285}{432} = 5 \text{ dolls. } 23 \text{ cts. } 8\frac{17}{16} \text{ ms.}$$

$$4. (20 \text{ ft.} + 14 \text{ ft. } 6 \text{ in.}) \times 2 = 69 \text{ feet round the room}$$

$$69 \text{ ft.} \times (10 \text{ ft. } 4 \text{ in.}) = 713 \text{ sq. feet in the walls}$$

$$(4 \text{ ft. } 4 \text{ in.}) \times 4 \text{ ft.} = 17 \text{ ft. } 4 \text{ inches fire place}$$

$$(3 \text{ ft. } 2 \text{ in.}) \times 6 \text{ ft.} \times 2 = 38 \text{ ft. } 0, \quad \text{two windows}$$

$$\text{Sum } 55 \text{ ft. } 4 \text{ in.} = 55\frac{1}{3} \text{ feet}$$

$$713 \text{ ft.} - 55\frac{1}{3} = 657\frac{2}{3} \quad \text{Lastly, } 657\frac{2}{3} \div 9 = 73\frac{2}{9}$$

$$5. (14 \text{ ft. } 5 \text{ in.} + 13 \text{ ft. } 2 \text{ in.}) \times 2 = 55 \text{ ft. } 2 \text{ inches round}$$

$$\text{Then, } (55 \text{ ft. } 2 \text{ in.}) \times (9 \text{ ft. } 3 \text{ in.}) = \begin{array}{r} 510 \text{ } 3 \text{ } 6 \\ 7 \text{ ft.} \times 4 \text{ ft.} = 28 \text{ } 0 \text{ } 0 \end{array}$$

$$\begin{array}{r} 9)482 \text{ } 3 \text{ } 6 \end{array}$$

Rendering 53 y. 5 ft. 3 in. 6 s.

$$\begin{array}{r} \text{ft. in.} \quad \text{in.} \quad \text{ft. in.} \\ 14 \text{ } 5 \text{ less } 10 = 13 \text{ } 7 \end{array} \quad \text{And } 13 \text{ ft. } 2 \text{ in.} - 10 \text{ in.} = 12 \text{ ft. } 4 \text{ in.}$$

$$\text{Then, } \frac{(13 \text{ ft. } 7 \text{ in.}) \times (12 \text{ ft. } 4 \text{ in.})}{9 \text{ feet}} = 18 \text{ yds. } 5 \text{ ft. } 6 \text{ in. } 4''$$

Page 177.

$$6. \frac{\overset{\text{feet in.}}{(105\ 6)} \times \overset{\text{feet in.}}{(275\ 5)}}{9\ \text{feet}} = \frac{105,5 \times 275 \frac{5}{8}}{9} = \frac{\text{square yards.}}{9} = 3228,41\frac{1}{8}$$

Then, $3228,41\frac{1}{8}$ sq. yds. $\times 12$ cts. = 387 d. 41 c. $9\frac{4}{8}$ m

$$7. (30\ \text{ft.}\ 6\ \text{in.} + 24\ \text{ft.}\ 9\ \text{in.}) \times 2 = 110\ 6 = 110,5\ \text{round}$$

$$110,5\ \text{ft.} \times 10\ \text{ft.} = 1105\ \text{square feet in the walls}$$

$$30,5\ ' \times 24\frac{3}{4}\ ' = 754,875\ \text{in the ceiling}$$

$$9) 1859,875$$

206,652 $\frac{7}{8}$ square yards
2 cents

$$\$4,13305\frac{7}{8}$$

Or, 4 dollars 13 cents 3 mills.

PAVERS' WORK.

Page 178.

$$2. \frac{(35\ \text{ft.}\ 4\ \text{in.}) \times (8\ \text{ft.}\ 3\ \text{in.})}{9} = \frac{35\frac{1}{2} \times 8,25}{9} = \frac{\text{square yards}}{9} = 32,3\frac{3}{8}$$

Then, $32,3\frac{3}{8}$ sq. yds. $\times 28$ cts. = 9 dolls. 06 cts. $8\frac{3}{8}$ mills

$$3. (27\ \text{ft.}\ 10\ \text{in.}) \times (14\ \text{ft.}\ 9\ \text{in.}) = 27\frac{5}{8} \times 14,75 = 410,54\frac{1}{8}\ \text{s. f.}$$

$$410,54\frac{1}{8} \div 9 = 45,61\frac{3}{8}\ \text{square yards}$$

Then, $45,61\frac{3}{8} \times 38$ cts. = 1733,39 $\frac{3}{8}$ cts. = 17 33 3,9+ d. cts. ms.

$$4. 45\ \text{feet} - 5\ \text{feet}\ 3\ \text{inches} = 39\ \text{feet}\ 9\ \text{inches}$$

$$\frac{63\ \text{ft.} \times (5\ \text{ft.}\ 3\ \text{in.})}{9} = 7 \times 5\frac{1}{4}\ \text{feet} = 36\frac{3}{4}\ \text{sq. yds. broad stones}$$

$$\frac{63\ \text{ft.} \times (39\ \text{ft.}\ 9\ \text{in.})}{9} = 7 \times 39\frac{3}{4}\ \text{ft.} = 278\frac{1}{4}\ \text{sq. yds. pebbles}$$

$$\text{Then, } 36\frac{3}{4}\ \text{square yards} \times 36\ \text{cts.} = 13\ 23$$

$$278\frac{1}{4}\ ' \times 30\ ' = 83\ 47\frac{1}{4}$$

Sum \$96 70 $\frac{1}{4}$

PAINTERS' WORK

Page 179.

$$\begin{array}{rcl}
 2. & (74 \text{ ft. } 10 \text{ in.}) \times (11 \text{ ft. } 7 \text{ in.}) = & \begin{array}{r} \text{ft.} \quad \text{in.} \quad \text{"} \\ 866 \quad 9 \quad 10 \end{array} \\
 & (7 \text{ ft. } 6 \text{ in.}) \times (3 \text{ ft. } 9 \text{ in.}) = & 28 \quad 1 \quad 6 \text{ door} \\
 & (6 \text{ ft. } 8 \text{ in.}) \times (3 \text{ ft. } 4 \text{ in.}) \times 5 = & 111 \quad 1 \quad 4 \text{ windows} \\
 & (22 \text{ ft. } 8 \text{ in.}) \times (1 \text{ ft. } 2 \text{ in.}) \times 5 = & 132 \quad 2 \quad 8 \text{ breaks}
 \end{array}$$

$$\begin{array}{rcl}
 & & \underline{1138 \quad 3 \quad 4} \\
 & (6 \text{ ft. } 9 \text{ in.}) \times 5 \text{ feet} = & 33 \quad 9 \quad 0 \text{ chimney} \\
 & & \underline{\hspace{1.5cm} \text{feet}} \\
 & & 1104 \quad 6 \quad 4 = 1104\frac{1}{2}
 \end{array}$$

And $1104\frac{1}{2} \div 9 = 122\frac{2}{3}\frac{3}{4}$ square yards

Then, $122\frac{2}{3}\frac{3}{4} \text{ s. yds.} \times 8\frac{1}{2} \text{ cts.} = 10 \text{ dolls. } 43 \text{ cts. } 1\frac{2}{3}\frac{1}{4} \text{ ms.}$

$$\begin{array}{rcl}
 3. & (20 \text{ ft. } + 14 \text{ ft. } 6 \text{ in.}) \times 2 = & 69 \text{ feet round} \\
 & 69 \text{ ft.} \times (10 \text{ ft. } 4 \text{ in.}) = & 69 \times 10\frac{1}{3} = 713 \text{ square feet}
 \end{array}$$

$$\begin{array}{rcl}
 & (4 \text{ ft. } 4 \text{ in.}) \times 4 \text{ ft.} = & 4\frac{1}{3} \times 4 = 17\frac{1}{3} \text{ feet fire place} \\
 & (3 \text{ ft. } 2 \text{ in.}) \times 6 \text{ ft.} \times 2 = & 3\frac{1}{6} \times 6 \times 2 = 38 \text{ feet windows}
 \end{array}$$

Sum $55\frac{1}{2}$

$$\text{Then, } \frac{713 - 55\frac{1}{2}}{9} = \frac{657\frac{2}{3}}{9} = 73\frac{2}{3}\frac{2}{7} \text{ square yards.}^*$$

Page 180.

$$\begin{array}{rcl}
 4. & (24 \text{ ft. } 6 \text{ in.} \times 16 \text{ ft. } 3 \text{ in.}) \times 2 = & \begin{array}{r} \text{ft.} \quad \text{in.} \quad \text{"} \\ 1039 \quad 1 \quad 6 \end{array} \\
 & (3 \text{ ft. } 6 \text{ in.}) \times 7 \text{ feet} = & 24 \quad 6 \quad 0 \text{ door} \\
 & (7 \text{ ft. } 9 \text{ in.}) \times (3 \text{ ft. } 6 \text{ in.}) \times 2 = & 54 \quad 3 \quad 0 \text{ w. shut.} \\
 & 24 \text{ ft.} \times (1 \text{ ft. } 3 \text{ in.}) \times 2 = & 60 \quad 0 \quad 0 \text{ breaks}
 \end{array}$$

$$\begin{array}{rcl}
 & & \underline{1177 \quad 10 \quad 6} \\
 & (5 \text{ ft. } 6 \text{ in.}) \times 5 \text{ feet} = & 27 \quad 6 \quad 0 \\
 & & \underline{\hspace{1.5cm}} \\
 & & 1150 \quad 4 \quad 6
 \end{array}$$

$$9)1150\frac{2}{3}$$

$$127\frac{2}{3}\frac{2}{3}$$

Then, $127\frac{2}{3}\frac{2}{3} \times 6 \text{ cts.} = 7 \text{ dolls. } 66 \text{ cts. } 9\frac{1}{2} \text{ ms.}$

*The same as question 4, plasterers' work.

GLAZIERS' WORK.

Page 181.

$$2. (7 \text{ ft. } 3 \text{ in.}) \times (3 \text{ ft. } 5 \text{ in.}) = 24 \text{ square feet } 9 \text{ in. } 3 \text{ sec.}$$

$$3. (6 \text{ ft. } 11 \text{ in.} + 5 \text{ ft. } 4 \text{ in.} + 4 \text{ ft. } 3 \text{ in.}) \times (3 \text{ ft. } 6 \text{ in.}) \times 7 = 16,5 \times 3,5 \times 7 = 404,25 \text{ square feet}$$

$$\text{Then, } 404,25 \text{ sq. ft.} \times 14\frac{1}{2} \text{ cts.} = 58 \text{ d. } 61 \text{ cts. } 6,25 \text{ ms.}$$

$$4. (12 \text{ ft. } 6 \text{ in.}) \times \left(\frac{16 \text{ ft. } 9 \text{ in.}}{2} \right) = 12,5 \times 8,375 = 104,6875 \text{ square feet}$$

$$\text{Then, } 104,6875 \text{ sq. ft.} \times 10 \text{ cts.} = 10 \text{ d. } 46 \text{ cts. } 8\frac{3}{4} \text{ ms.}$$

$$5. (14 \text{ ft. } 6 \text{ in.}) \times (4 \text{ ft. } 9 \text{ in.}) = 68 \text{ sq. ft. } 10 \text{ in. } 6 \text{ sec.}$$

$$6. (7 \text{ ft. } 10 \text{ in.} + 6 \text{ ft. } 8 \text{ in.} + 5 \text{ ft. } 4 \text{ in.}) \times (3 \text{ ft. } 11 \text{ in.}) \times 9 =$$

$$19\frac{1}{2} \times 3\frac{1}{2} \times 9 = \frac{119}{2} \times \frac{47}{4} \times 9 = 5\frac{9}{8} \times 3 = 699\frac{1}{8} \text{ square feet}$$

$$\text{Then, } 699\frac{1}{8} \text{ square feet} \times 14 \text{ cents} = 97 \text{ dollars } 87\frac{3}{4} \text{ cents}$$

MEASUREMENT OF GROUND.

1st. To find the content of a square piece of ground.

Page 182.

$$2. 35 \times 2 = 70 \text{ perches}$$

$$\text{Then, } 70 \times 70 = 4900 \text{ square feet} = 30 \text{ A. } 2 \text{ R. } 20 \text{ P.}$$

$$3. 16\frac{1}{2} \times 16\frac{1}{2} = 16,5 \times 16,5 = 272,25 = 1 \text{ } 2 \text{ } 32\frac{1}{4} \text{ sq. perches A. R. P.}$$

2d. To find the content of an oblong piece of ground, called a parallelogram.

Page 183.

$$2. \frac{120 \text{ perches} \times 84 \text{ perches}}{160 \text{ perches}} = 63 \text{ acres}$$

Page 183.

$$3. \frac{240 \times 120}{16\frac{1}{2} \times 16\frac{1}{2}} = \frac{28800}{272\frac{1}{4}} = 105 \text{ perches } 213\frac{3}{4} \text{ feet}$$

But, 105 per. $213\frac{3}{4} = 2 \text{ rods } 25 \text{ perches } 213\frac{3}{4} \text{ feet}$

3d. *To find the content of a triangular piece of ground.*

Page 184.

$$2. 75 \times \frac{1}{2} = 75 \times 25 = 1875 \text{ per.} = 11 \text{ A. } 2 \text{ R. } 35 \text{ P.}$$

$$3. 120 \times \frac{3}{2} = 120 \times 42 = 5040 \text{ per.} = 31 \text{ acres } 2 \text{ roods}$$

A. R. dolls.

dolls. cts.

$$\text{Then, } (31 \ 2) \times 45 = 31,5 \times 45 = 1417 \ 50$$

$$4. 140 \text{ ft.} \times \frac{7}{2} \text{ ft.} = 140 \times 35 = 4900 \text{ square feet}$$

$$\text{Then } 4900 \div 9 = 544 \text{ yards } 4 \text{ feet.}$$

4th. *To find the content of a piece of ground, in the form of an oblique parallelogram.*

Page 185.

$$2. (80 \times 24) \div 160 = 12 \text{ acres}$$

5th. *To find the content of a piece of ground bounded by four sides, none of which are parallel or equal.*

Page 186.

$$2. \frac{120 \times (48 + 24)}{2} = 4320 \text{ perches} = 27 \text{ acres}$$

6th. *To find the area of a piece of ground lying in a circle, or ellipsis.*

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perches A. R. P.

$$2. 30 \times 20 \times,7854 = 471,24 = 2 \ 3 \ 31,24$$

$$3. 160 \times 160 \times,7854 = 20106,24 \text{ square feet}$$

$$\text{But, } 20106,24 \div 9 = 2234,02\frac{2}{3} \text{ square feet.}$$

11*

GAUGING.

Page 189.

$$2. \quad 28 + \frac{2}{3}(24-18) = 18 + 4 = 22 \text{ mean diameter}$$

$$\text{Then, } \frac{22 \times 22 \times 24}{49} = \frac{11936}{49} = 39\frac{25}{49} \text{ gallons}$$

$$3. \quad 28 + \frac{2}{3}(36-28) = 28 + 5\frac{1}{3} = 33\frac{1}{3} \text{ mean diameter}$$

$$\text{Then, } \frac{33\frac{1}{3} \times 33\frac{1}{3} \times 40}{294} = \frac{100 \times 100 \times 40}{9 \times 294} = \frac{200000}{147} = 151\frac{227}{147} \text{ gallons}$$

$$4. \quad 15 + \frac{2}{3}(18-15) = 15 + 2 = 17 \text{ mean diameter}$$

$$\text{Then, } \frac{17 \times 17 \times 29}{359} = \frac{8381}{359} = 23\frac{124}{359} \text{ gallons}$$

$$5. \quad 18 + \frac{2}{3}(22-18) = 18 + 2\frac{2}{3} = 20\frac{2}{3} \text{ mean diameter}$$

$$\text{Then, } \frac{20\frac{2}{3} \times 20\frac{2}{3} \times 36}{359} = \frac{62 \times 62 \times 36}{9 \times 359} = \frac{15376}{359} = 42\frac{298}{359} \text{ gallons}$$

MECHANICAL POWERS.

1st. THE LEVER.

Page 190.

As 1 inch : 20 inches :: 5 lb. : 100 pounds the answer

2d. THE WHEEL AND AXLE.

Page 191.

As 60 inches (= 5 lb.) : 6 inches :: 10 lb. : 1 lb.

PROMISCUOUS QUESTIONS.

Page 192.

Quest. 1. $2578 + 2578 = 5156$

2. $14676 - 14\frac{6}{4}76 = 14676 - 3669 = 11007$

3. $1468 - (461 + 581) = 1468 - 1042 = 426$

4. $\frac{1}{3}$ of 100 cents $= 33\frac{1}{3}$ cents
 $\frac{1}{2}$ of $\frac{1}{3} = \frac{1}{6}$ of 100 cts. $= 16\frac{2}{3}$

Sum 50 cents

5. $1080 \div 45 = 24$ the number required

6. $(476)^2 \div 47\frac{6}{2} = 22\frac{6}{2}576 = 952$

7. Suppose one side of the square to consist of 100 men

Then, $100^2 + 231 = 10231$ the whole number of men

And $101^2 - 44 = 10157$ the whole of the men

74 error too little

Again, suppose the side of the square to have 120 men

Then, $120^2 + 231 = 14631$ the whole number of men

And $121^2 - 44 = 14597$ the whole number of men

34 error too little

Errors alike.

Then, $\frac{(120 \times 74) - (100 \times 34)}{74 - 34} = 137\frac{480}{40} = 137$ men on one side

Lastly, $(137)^2 + 231$, or $(138)^2 - 44 = 19000$ men

8. $113 \times 147 - 21^3 = 16611 - 9261 = 7350$

9. $\frac{3}{4}$ of $\frac{3}{8} = \frac{2}{8} = \frac{1}{4}$ then, as $\frac{1}{4} : 1260 \text{ d.} :: 1 : 5040 \text{ dolls.}$

10. $3500 - 2500 = 1000$ dollars

Then, 2500 dollars } dolls. { 100 dollars
 8 years } 1000 { 1 year

40

Lastly, $\frac{1000 \times 100}{2500 \times 8} = 5$ per cent.

Page 193.

$$11. \text{ As } \frac{2}{3} : 210 :: 1 : \frac{210 \times 3}{2} = \$315 \text{ elder brother's por.}$$

$$\text{Now, } 315 \times 3 \times 2 = 1890 \text{ dollars}$$

$$12. (650 - 130) \times 400 = 520 \text{ d. } \times 4 \text{ dolls} = 2080 \text{ dolls.}$$

$$13. 17 + 8 + 46 + (20 \times 2) = 111 \text{ years}$$

$$14. 1000 - (350 + 400) = 250 \text{ dollars C's share}$$

*dolls. dolls.**dolls. dolls.*

Then, as 250 : 500 :: as 1 : 2 :: 350 : 700 A put in

And, as 1 : 2 :: 400 dolls. : 800 dolls. B's cloth is worth

$$15. \frac{1}{2} \text{ of } 2720 = 544 \text{ dollars the captain's share}$$

$$\text{Then, } \frac{2720 - 544}{160} = \frac{2176}{160} = 13 \text{ d. 60 cts. a sailor's share}$$

$$16. \text{ As } 6 : 100 :: 972 \text{ dolls. : } 16200 \text{ dolls. her portion}$$

$$\text{And, as } \frac{2}{3} : 16200 \text{ dollars :: } 1 : 27000 \text{ dollars}$$

$$\text{Then, } 27000 \div 3 = 9000 \text{ d. int. of the father's estate 1 year}$$

dolls. dolls.

$$\text{Lastly, as } 6 : 100 :: 9000 : 150000 \text{ the father's estate}$$

$$17. (4 \text{ ft. } 6 \text{ in.}) \times (2 \text{ ft. } 9 \text{ in.}) \times (3 \text{ ft. } 4 \text{ in.}) = 41 \text{ sq. ft. } 3 \text{ in.}$$

$$18. \frac{1}{9} + \frac{5}{6} = \frac{2 + 15}{18} = \frac{17}{18} \text{ and } 1 - \frac{17}{18} = \frac{1}{18}$$

$$\text{Then, as } \frac{1}{18} : 12 :: 1 : 12 \times 18 = 216 \text{ feet}$$

Page 194.

$$19. \frac{112 \times \frac{4}{7}}{3} = \frac{64}{3} = 21\frac{1}{3} \text{ years}$$

$$20. \text{ As } \frac{2}{30} (= \frac{2}{4} \text{ of } \frac{3}{4}) : 1710 :: 1 : \frac{1710 \times 20}{9} = 3800 \text{ dolls.}$$

$$21. 62^2 (\frac{63}{2})^2 = 3969 \times 992,25 = 3938240,25 \text{ product}$$

$$\text{And } (63 \times \frac{63}{2}) - (63 + \frac{63}{2}) = 1984,5 - 94,5 = 1890 \text{ diff.}$$

*mi.**day miles**da. h. min.*

$$22. \text{ As } 68 (= 34 \times 2) : 1 :: 2000 : \frac{2000}{29} = 29 \text{ } 9 \text{ } 52\frac{1}{2}$$

Page 194.

$$23. \begin{array}{c} \text{lb. times} \quad \text{lb.} \quad \text{C. qr. lb.} \\ 6 : 2 :: 885 (=7 \ 3 \ 17) : \frac{885 \times 2}{6} = 295 \text{ times} \end{array}$$

$$24. \text{ Suppose } 1, \text{ then } 1 + \frac{2}{3} = \frac{5}{3} \text{ sum}$$

$$\text{And, as } \frac{5}{3} : 1 :: 20 : \frac{20 \times 3}{5} = 12$$

$$25. 21 \times \frac{3}{4} = \frac{63}{4} = 15 \frac{3}{4}$$

$$26. \frac{3}{4} \div 15 = \frac{3}{4} \times \frac{1}{15} = \frac{3}{60} = \frac{1}{20}$$

$$27. \frac{3}{8} + \frac{1}{8} = \frac{24+5}{40} = \frac{29}{40}$$

$$28. \text{ Suppose the number to be } 6$$

Then, $6 \times 3 - 8 = 10$ the whole of his money

And, $6 \times 2 + 3 = 15$ the whole of his money

—
5 error

Again, suppose 10 to be the number

Then, $10 \times 3 - 8 = 22$ his money

And, $10 \times 2 + 3 = 23$ his money

—
1 error

Errors alike,

$$\text{Now, } \frac{5 \times 10 - 6 \times 1}{5 - 1} = \frac{44}{4} = 11 \text{ children}$$

$$29. \begin{array}{l} \text{Inverse } 100 \text{ dollars } \left\{ \begin{array}{l} \text{year} \\ 6 \text{ dollars} \end{array} \right\} \begin{array}{l} 500 \text{ dollars inverse} \\ 1 \end{array} \left\{ \begin{array}{l} 500 \text{ dollars} \\ 500 \text{ dollars} \end{array} \right. \end{array}$$

$$\text{Then, } \frac{500 \times 100}{6 \times 500} = \frac{100}{6} = 16 \text{ years } 8 \text{ months}$$

$$30. \text{ Suppose the number to be } 100$$

Then, $100 + 15 + 100 + 10 = 108 \frac{1}{3}$ the members

But, $108 \frac{1}{3} - 100 = 8 \frac{1}{3}$ error too little

Again, suppose 200 members in all

Then, $200 + 15 + 200 + 10 = 191 \frac{2}{3}$ the members

But, $200 - 191 \frac{2}{3} = 8 \frac{1}{3}$ error too much

Errors unlike.

$$\text{Lastly, } \frac{200 \times 8 \frac{1}{3} + 100 \times 8 \frac{1}{3}}{8 \frac{1}{3} + 8 \frac{1}{3}} = \frac{200 + 100}{1 + 1} = \frac{300}{2} = 150$$

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31. $360 \text{ deg.} \times 69\frac{1}{2} \text{ miles} = 25020 \text{ miles round the earth}$
 Then, as 20 miles : 1 day :: 25020 : $\frac{25020}{20} = 1251 \text{ days}$
 Lastly, $1251 \text{ days} \div 365\frac{1}{4} \text{ days} = 3 \text{ years } 155\frac{1}{4} \text{ days}$

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$$\begin{array}{r} 32. \quad 100 \times 3\frac{1}{4} = 325 \\ 150 \times 4\frac{1}{2} = 675 \\ 204 \times 5\frac{3}{4} = 1173 \\ \hline \end{array}$$

$$454 \quad)2173 (4 \text{ months } 23\frac{1}{2}\frac{3}{4} \text{ days}$$

*da. w. da. w.*33. As 7 : 1 :: 1 : $\frac{1}{7}$ A can do alone in one dayAnd, as 12 : 1 :: 1 : $\frac{1}{12}$ the part B can do in a day

Then, $\frac{1}{7} + \frac{1}{12} = \frac{12+7}{84} = \frac{19}{84}$ the part of the work that they
 can do in a day, working together

Lastly, as $\frac{19}{84}$ work : 1 day :: 1 work : $\frac{84}{19} = 4\frac{8}{19}$ days

$$34. \quad \frac{(1,05^7 - 1) \times 400^*}{1,05 - 1} = \frac{4,071,004,226,562,5 \times 400}{,05} \\ = 3256,803,381,25 = 3256 \text{ dollars } 80 \text{ cents } 3 \text{ mills}$$

*mo. dolls. mo. d.*35. As 12 : 5 :: 4 : $1\frac{2}{3}$ and $100 + 1\frac{2}{3} = 101\frac{2}{3}$

Then,

$$\text{As } \frac{101\frac{2}{3}}{3} (= 101\frac{2}{3}) : 100 :: \frac{\text{dolls.}}{700} : \frac{\text{dolls.}}{305} = \frac{100 \times 700 \times 3}{305} = 688 \text{ } 52 \text{ } 4\frac{3}{5}$$

$$36. \quad \frac{3}{8} + \frac{3}{7} = \frac{21+24}{56} = \frac{45}{56} \text{ and } 1 - \frac{45}{56} = \frac{11}{56} \text{ C's parts}$$

$$\text{Then, as } \frac{11}{56} : 140 :: \frac{3}{8} : \frac{\overset{7}{56} \times 140 \times 3}{11 \times 8} = \frac{2940}{11} = 267 \text{ d. } 27\frac{3}{11} \text{ c.} \quad \text{A paid}$$

$$\text{And, as } \frac{11}{56} : 140 :: \frac{3}{7} : \frac{\overset{8}{56} \times 140 \times 3}{11 \times 7} = \frac{3360}{11} = 305 \text{ } 45\frac{5}{11} \text{ B paid}$$

$$\text{*RULE. } A = \frac{(R^t - 1) \times u}{R - 1} \text{ Here } u = \text{the annuity } R =$$

the ratio or amount of £.1, or \$1, in one year as in compound interest; t = the time for which the annuity is in arrear. A = the amount of annuity at the end of t years.

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37. Suppose the number to be 12.

Then, $12 \times 4 + 16 = 64$ his money

And, $12 \times 6 - 12 = 60$ his money

4 error too little

Again, Suppose 20 to be the number of beggars

Then, $20 \times 4 + 16 = 96$ his money

And $20 \times 6 - 12 = 108$ his money

12 error too much

Errors unlike.

Then, $\frac{12 \times 12 + 20 \times 4}{12 + 4} = \frac{224}{16} = 14$ beggars

38. As $18 : 1 :: 1 : \frac{1}{18}$ the part B and C can do in a day working together.

And, as $11 : 1 :: 1 : \frac{1}{11}$ the part of the work they can do in a day, all working

Now, $\frac{1}{11} - \frac{1}{18} = \frac{18-11}{198} = \frac{7}{198}$ the part of the work that

A can do in a day

Lastly, as $\frac{7}{198} : 1 :: 1 : \frac{198}{7} = 28$ days. 3 hrs. 25 $\frac{1}{2}$ min.

39. 20 congress each spends $\frac{1}{4} = 5$ dollars

30 merchants each spends $\frac{1}{5} = 6$ ‘

24 lawyers each spends $\frac{1}{8} = 3$ ‘

24 citizens each spends $\frac{1}{3} = 2$ ‘

16

d. dolls.

Then, as 16 : 192 :: $\left\{ \begin{array}{l} 5 : 60 \text{ paid by the congress} \\ 6 : 72 \text{ merchants} \\ 3 : 36 \text{ lawyers} \\ 2 : 24 \text{ citizens} \end{array} \right.$

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40. $28 \times 20 = 560$ square inches

$14 \times 10 \times 2 = 280$ ‘ ‘

280 = $1\frac{1}{2}$ acres

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41. 200 acres = 32000 perches = b 40 perches = a . The rule is,* $\sqrt{(\frac{a^2}{2} + b)}$ — $\frac{a}{2}$ the short side, and $\sqrt{(\frac{a^2}{2} + b)} + \frac{a}{2}$ the long sideThus, $\sqrt{(\frac{40^2}{2} + 32000)} - \frac{40}{2} = 160$ the short sideAnd, $\sqrt{(\frac{40^2}{2} + 32000)} + \frac{40}{2} = 200$ the longer side

42. Suppose the side of the square meadow to be 1;

Then, $\sqrt{1^2 + 1^2} = \sqrt{2} = 1,4142136$ its diagonalAnd, $1,4142136 - 1 = ,4142136$ what the diagonal is more than the sideNow say, as $,4142136 : 1 :: 20 : 48,28425$ the side of the required square in perches. Lastly, square the side, and we get the contents 2331,37 perches = 14a. 2r. 11p.†43. As $\frac{L}{l} : \frac{ft.}{pence} :: 24000 (=100) : 2\frac{4000}{18} = 4\frac{000}{3}$ square ft.And, $4\frac{000}{3} \div \frac{83}{2} = 4\frac{000}{3} \times \frac{1}{41} = 1\frac{000}{33}$ feet perpendicularThen, $\sqrt{(44^2 + 1\frac{000}{33}^2)} = \frac{1}{33} \sqrt{(44^2 \times 33^2 + 1000^2)} = \frac{4}{33}$ $\sqrt{(11^2 \times 33^2 + 250^2)} = \frac{4}{33} \sqrt{194269}$ one of the equal sides; consequently $\frac{8}{33} \sqrt{194269} = 106,85$ &c. the sum required.*Solution by Algebra.** Let x = the short side, a = the difference of the sides, and b = the contents in perchesThen, $(x+a) \times x$ = the contents of the ground in perches,That is, $x^2 + ax = b$ by the question. — By completing the square we get $x^2 + ax + \frac{a^2}{4} = \frac{a^2}{4} + b$; and by evolution $x + \frac{a}{2} = \sqrt{\frac{a^2}{4} + b}$, consequently $x = \sqrt{\frac{a^2}{4} + b} - \frac{a}{2}$ † Put x = the side of the square, and $a = 20$.Then, (Euclid 1. 47) $2x^2 = (x+a)^2 = x^2 + 2ax + a^2$ by transposition we get $x^2 - 2ax = a^2$ and by completing the square $x^2 - 2ax + a^2 = 2a^2$, by evolution $x - a = \sqrt{2a^2}$ hence $x = a + a\sqrt{2}$. Now by restoring the value of a we get x the side of the square to be $20 + 20\sqrt{2} = 20 + 20 \times 1,4142136 = 48,284272$ perches in the side the same as above, whence the contents may be readily found.

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Question 43 continued. Or, decimally

As, 18 : 1 :: 24000 : 1333,33 &c. square feet

And, $\frac{1333,53}{44} = 30,303 \text{ \&c. the perpendicular}$

Then, $2 \sqrt{44^2 + 30,303^2} = 2\sqrt{2854,27 +} = 106,83 \text{ feet}$

44. Half an acre 80 per. $\times 30\frac{1}{4} = 2420 \text{ square yards}$

Then, $\frac{2420}{,7854} = 3081,23 \text{ the square of the diameter.}$

Lastly, $\frac{\sqrt{3081,23}}{2} = \frac{55,5}{2} = 27,75 \text{ yards}$

45. 114 yards 6 feet = 1032 square feet

Then, $1032 \div 28 = 36\frac{6}{7} \text{ feet}$

46. $\frac{7 \times 2\frac{1}{2} \times 2}{3} = \frac{35}{3} = 11\frac{2}{3} \text{ inches}$

47. 20 feet = 240 inches

And, $240 \times 1\frac{1}{4} \times 1\frac{1}{4} = 240 \times \frac{5}{4} \times \frac{5}{4} = \frac{6000}{16} = 375 \text{ cubic inches}$

Half a ton is 1120 pounds; also, 50 feet = 600 inches

And, $600 \times \frac{7}{8} \times \frac{7}{8} = \frac{29400}{64} = 459\frac{3}{8} \text{ cubic inches}$

Then, as $\begin{matrix} \text{cubic in.} & \text{lb.} & \text{cubic in.} & \text{lb.} \end{matrix}$ 375 : 1120 :: 459 $\frac{3}{8}$: 1372

Lastly, as $\begin{matrix} \text{lb.} & \text{d.} & \text{lb.} & \text{pence} & \text{L.} & \text{s.} & \text{d.} \end{matrix}$ 1 : 3 $\frac{1}{4}$:: 1372 : 4802 = 20 0 2

48. Here $\sqrt{39^2 - 15^2} = \sqrt{1521 - 225} = \sqrt{1296} =$

36 feet standing

Then, $36 + 39 = 75 \text{ feet the whole height}$

49. Here work backwards

Thus, $24 \times 9 = 216$; $\sqrt[3]{216} = 6$; $6 \times \frac{4}{3} = 8$; $8^2 = 64$; $64 - 4 = 60$; $60 \div 5 = 12$; $12 \times 8 = 96$; lastly, $96 \div 7 = 103$.

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50. Here the several portions of wine drawn off were

50, remains 450
 $\frac{50 \times 450}{500}$ remains 450 — $\frac{50 \times 450}{500} = \frac{450^2}{500}$

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Question 50 continued.

$$\frac{50 \times 450^3}{500^3} \text{ remains } \frac{450^3}{500} - \frac{50 \times 450^3}{500^2} = \frac{450^3}{500^2}$$

$$\frac{50 \times 450^3}{500^3} \text{ remains } \frac{450^3}{500^2} - \frac{50 \times 450^3}{500^3} = \frac{450^4}{500^3}$$

$$\frac{50 \times 450^4}{500^4} \text{ remains } \frac{450^4}{500^3} - \frac{50 \times 450^4}{500^4} = \frac{450^5}{500^4}$$

$$\text{Therefore, } \frac{450^5}{500^4} = \frac{18452812500000}{62500000000} = 295\frac{49}{1000} \text{ gallons of wine}$$

$$\text{Consequently, } 500 - 295\frac{49}{1000} = 204\frac{151}{1000} \text{ galls. of water*}$$

**Analytically.* Put $500=c$, $50=d$, $5=t$, and x =what wine remains after drawing t times

Then, $c-d$ expresses the quantity of wine left after the first drawing; $c : c-d :: d : \frac{(c-d) \times d}{c}$ the quantity of wine

drawn out at the second drawing, and $c-d - \frac{(c-d) \times d}{c} = \frac{(c-d)^2}{c}$ the quantity of wine left after the second drawing.

Also, $c : \frac{(c-d)^2}{c} :: d : \frac{(c-d) \times d}{c^2}$ the quantity of wine drawn out at the third drawing.

And, $\frac{(c-d)^2}{c} - \frac{(c-d)^2 \times d}{c^2} = \frac{(c-d)^3}{c^2}$ the quantity of wine left after the third drawing; and universally—

$c : \frac{(c-d)^{t-1}}{c^{t-2}} :: d : \frac{(c-d)^{t-1}}{c^{t-1}} \times d$ the quantity of wine drawn out at the t drawing.

And, $\frac{c-d}{c^{t-2}} - \frac{(c-d)^{t-1}}{c^{t-1}} = \frac{(c-d)^t}{c^t} = x$ the quantity of wine remaining after the t drawing. By substituting the values of c , d , and t , in this formula, we get

$$\frac{(500-50)^5}{500^4} = \frac{450^5}{500^4} = 295\frac{49}{1000} \text{ galls. of wine the same as above}$$

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51. $\frac{2 \times 2 \times 4}{4 \times 4 \times 8} = \frac{16}{128} = \frac{1}{8}$ part

52. 1817, April 1st. principal 1864 dollars

Oct. 15th 1864 doll. mult. by 197 days = 367208

Paid 225,50

1818 Jan. 10th 1638,50 \times 87 = 142549,5
Paid 188,86

May 16th 1449,64 \times 126 = 182654,64
Paid 585

Aug. 1st. 864,64 \times 77 = 66577,28
Interest 126,49

Balance \$991,13

6|0)75898|9,42

Interest \$126,49

53. $\frac{36 \times 6\frac{1}{2} \times 8\frac{3}{4}}{128} = \frac{2047\frac{1}{2}}{128} = 15\frac{255}{256}$ cords

54. As $\begin{matrix} \text{days} & \text{dolls.} & \text{cts.} & \text{day} \\ 365 & : & 356 & 34 :: 1 : 97 \end{matrix}$ cents $6\frac{2}{3}$ mills

55. As $\begin{matrix} \text{cts.} & \text{doll.} & \text{dolls.} & \text{cts.} & \text{dolls.} & \text{cts.} \\ 18\frac{3}{4} & : & 1 :: 2564 & 95\frac{1}{2} : & 13679 & 76 \end{matrix}$

56. Inverse 8 men } $\begin{matrix} \text{days} \\ \$20,50 \end{matrix}$ { 64 men inverse
30 } 100 dollars

Then, $\frac{30 \times 8 \times 100}{64 \times 2050} = \frac{30 \times 25}{41} = 18\frac{12}{41}$ days

57. Inverse 34 men } $\begin{matrix} \text{months} \\ 1 \text{ bridge} \end{matrix}$ { 86 men inverse
6 } 2 bridge

Then, $\frac{6 \times 34 \times 2}{86 \times 1} = \frac{408}{86} = 4\frac{32}{43}$ months

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58. As $4 : 6 :: 7 : 10\frac{1}{2} = 10,5$ dollars C must pay when A pays 5 dollars and B 7 dollars.

And, $5 + 7 + 10\frac{1}{2} = 22\frac{1}{2} = 22,5$ dollars

$$\begin{array}{l} \text{dolls.} \quad \text{dolls.} \\ \text{Lastly, as } 22,5 : 240 :: \left\{ \begin{array}{l} 5 : \$ 53 \ 33\frac{1}{2} \text{ A receives} \\ 7 : \$ 74 \ 66\frac{2}{3} \text{ B} \\ 10,5 : \$ 112 \ 00 \text{ C} \end{array} \right. \end{array}$$

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dolls. cts. ms. dolls. cts. dolls. cts.

59. As $100 : 7 \ 3 :: 8564 \ 20 : 6 \ 25 + \text{tax}$

60. (4 galls. 2 qt.) — (2 galls. 2 qt. 1 pt.) = 1 gall. 3 qt. 1 pt. = 15 pints gained, or remaining in the vessel at the end of one hour.

And, $84\frac{1}{2}$ gallons is 676 pints

Then, as 15 pts. : 1 hr. :: 676 pints : 45 hours 4 minutes

61. One acre $\overset{P.}{160} \times \overset{ft.}{16},5 \times \overset{ft.}{16},5 = 160 \times 272\frac{1}{4} = \overset{sq. \text{ feet}}{43560}$

Then, $43560 \div 36 = 1210$ feet = $73\frac{1}{2}$ perches

62. $\begin{array}{l} 50 \text{ men} \\ 30 \text{ days} \end{array} \left\{ \begin{array}{l} \text{bushels} \\ 12 \end{array} \right\} \begin{array}{l} 40 \text{ men} \\ 90 \text{ days} \end{array}$

$$\begin{array}{c} 3 \\ \text{Then, } \frac{12 \times 40 \times \cancel{30}}{50 \times \cancel{30}} \times \frac{12 \times 4 \times 3}{5} = 1\frac{4}{5}^4 = 28\frac{4}{5} \text{ bushels} \end{array}$$

63. $\begin{array}{l} \text{Boy} \quad 1 \times 6 = 6 \text{ cents} \\ \text{Women } 3 \times 8 = 24 \text{ ' } \\ \text{Men} \quad 6 \times 16 = 96 \text{ ' } \end{array}$

126 cents

$$\begin{array}{l} \text{cents} \quad \text{cents} \\ \text{Then, as } 126 : 1890 :: \left\{ \begin{array}{l} 6 : 90 \text{ cents the boys get} \\ 24 : 360 \text{ cents the women get} \\ 96 : 1440 \text{ cents the men get} \end{array} \right. \end{array}$$

$$\begin{array}{l} \text{Consequently, } 90 \div 6 = 15 \text{ boys} \\ \quad \quad \quad 360 \div 8 = 45 \text{ women} \\ \text{And } 1440 \div 16 = 90 \text{ men} \end{array} \left\{ \right.$$

64. $7 \times 4\frac{1}{2} - 8 \times 3 = 31\frac{1}{2} - 24 = 7\frac{1}{2}$ miles apart in one day
Then, as 1 day : $7\frac{1}{2}$ mi. :: 13 days : $97\frac{1}{2}$ miles apart

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$$65. \quad \begin{array}{r} 962 \times 6 = 5772 \\ 320 \end{array} \quad \begin{array}{r} 1635 \times 3\frac{1}{2} = 5722\frac{1}{2} \\ 408\frac{1}{2} \end{array}$$

$$\begin{array}{r} 1282 \times 6 = 7692 \\ \hline \end{array} \quad \begin{array}{r} 1226\frac{1}{2} \times 5 = 6131,25 \\ \hline \end{array}$$

A 13464

B 11853,75

A 13464

B 11853,75

25317,75 Then,

$$\begin{array}{l} \text{dolls. cts. ms.} \\ \text{As } 25317,75 : 486 \text{ } 64 :: \left\{ \begin{array}{l} 13464 : 258,79,51\frac{34}{100} \\ 11853,75 : 227,84,41\frac{53}{100} \end{array} \right. \end{array}$$

Proof \$486,64

$$66. \quad \text{Here } \frac{5280^3 \times 2^3}{2500 \times 6 \times 5280 \times 3} =$$

$$\begin{array}{r} 44 \\ \cancel{2500} \times \cancel{5280} \times \cancel{5280} \times 8 \\ \hline \cancel{2500} \times \cancel{6} \times \cancel{5280} \times 3 \end{array} = \frac{44 \times 1056 \times 8}{25 \times 3} = \frac{371712}{75}$$

$$= 4956\frac{4}{5} \text{ hours} = 206 \text{ days } 12 \text{ hours } 9 \text{ min. } 36 \text{ seconds}$$

$$67. \quad 45\frac{1}{2} \text{ ft.} - 9\frac{1}{2} \text{ in.} = 546 \text{ in.} - 9\frac{1}{2} \text{ in.} = 536\frac{1}{2} \text{ inches}$$

$$\text{And } 9\frac{1}{2} \text{ in.} - 6\frac{3}{4} \text{ in.} = 2\frac{1}{4} \text{ inches gained in a day}$$

$$\text{Now, } 536\frac{1}{2} \div 2\frac{1}{4} = 107\frac{3}{2} \times \frac{4}{11} = 21\frac{14}{11} = 195\frac{1}{11} \text{ days}$$

That is, it will be within $9\frac{1}{2}$ inches of the top in $195\frac{1}{11}$ days. Consequently it will get to the top in $196\frac{1}{11}$ days.

$$68. \quad \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{8} = \frac{180 + 72 + 45 + 40}{360} = \frac{337}{360}$$

$$\text{And } 1 - \frac{337}{360} = \frac{23}{360} \text{ Then,}$$

$$\text{As } \frac{23}{360} : 46 :: 1 : \frac{46 \times 360}{23} = 720 \text{ trees}$$

12 *

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69. Suppose 200 dolls. Again, Suppose 300 dollars

$\begin{array}{r} 94 \\ \hline 106 \end{array}$	$\begin{array}{r} 94 \\ \hline 206 \end{array}$
$\frac{1}{4}$ of 106 = 53 lent	$\frac{1}{4}$ of 206 = 103 lent
$\frac{1}{2}$ of 106 = 21 $\frac{1}{2}$ clothes	$\frac{1}{2}$ of 206 = 41 $\frac{1}{2}$ clothes
$\begin{array}{r} 94 \text{ debts} \\ \hline \end{array}$	$\begin{array}{r} 94 \text{ debts} \\ \hline \end{array}$
$\begin{array}{r} \$168\frac{1}{2} \text{ sum gone} \\ \hline \end{array}$	$\begin{array}{r} \$238\frac{1}{2} \text{ sum gone} \\ \hline \end{array}$
$\frac{9}{10}$ of 200 = 180	$\frac{9}{10}$ of 300 = 270
$\begin{array}{r} 11\frac{1}{2} \text{ error too much} \\ \hline \end{array}$	$\begin{array}{r} \text{error } 31\frac{1}{2} \text{ too much} \\ \hline \end{array}$

Errors alike.

$$\text{Then, } \frac{200 \times 31\frac{1}{2} - 300 \times 11\frac{1}{2}}{31\frac{1}{2} - 11\frac{1}{2}} = \frac{6360 - 3540}{20} = 141 \text{ dolls.}$$

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$$70. \quad \frac{1}{2} - \frac{1}{4} = \frac{4-3}{12} = \frac{1}{12}$$

$$\text{Then, as } \frac{1}{12} : 84 :: 1 : 84 \times 12 = 1008$$

71. Here $3 - 2 : 4 \text{ ft.} :: 3 : 12$ feet the semidiameter of the circle that the outer wheel makes. Consequently $12 \times 2 = 24$ feet the diameter of the outer circle.

And, $24 - 4 \times 2 = 16$ feet the diameter of the inner circle

Lastly, $24 \times 3,1416 = 75,3984$ feet by the outer wheel

And, $16 \times 3,1416 = 50,2656$ feet by the inner wheel

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72. Here* $1\frac{2}{3}$ = one of the equal sides, $1\frac{2}{3}$ = half the sum of the sides

$$\text{And } 1\frac{2}{3} - 1\frac{2}{3} = \frac{375 - 250}{6} = 1\frac{2}{3} \text{ one of the equal sides.}$$

$$\text{Then, } \sqrt{1\frac{2}{3} \times 1\frac{2}{3} \times 1\frac{2}{3} \times 1\frac{2}{3}} = \frac{125^2}{6} \sqrt{1\frac{2}{3}} = \frac{125^2}{6} \times \frac{1}{2} \sqrt{3} =$$

$$\frac{125^2}{6^2} \sqrt{3} = \frac{15625}{36} \sqrt{3} = \frac{15625 \times 1,732,0508}{36} =$$

751,75816 square feet.

Or, by RULE II, thus; $125 \div 3 = 1\frac{2}{3}$ is one of the equal sides of the triangle, and because the triangle is equilateral, and consequently equiangular, the included angle of any two sides is 60° , whose natural sine is ,8660254

$$\text{Hence, } 1\frac{2}{3} \times 1\frac{2}{3} \times ,8660254 = 751,7581596 \text{ square feet}$$

* Here data is given to find the sides.

The rule for solving this question, and all of a similar kind, is by mensuration, as follows:

1. From half the sum of three sides subtract each side severally.
2. Multiply the half sum and the three remainders continually together, and the square root of the product will be the area required.

RULE. II. Any two sides of a triangle being multiplied together, and the product again by half the natural sine of there included angle, will give the area of the triangle.

That is, $AC \times CB \times \text{natural sine of the angle } C = \text{twice area.}$



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